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Four target areas in the D.C. region were studied in detail: the D.C. Core, Rosslyn, Va., Silver Spring, Md., and Centreville, Va. A regional plan was then developed from information gathered in the target area studies, including an anlysis of regionwide parking related goals and problems.

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FOR
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FOREWORD

The Agency's many lesislative mandates, calling for improved environmental quality nationwide, specify delegation of authority to state or designated regional and local governments for implementation of the programs. In addition, the legislation requires consideration of nonstructural concepts for reducing pollution, as well as the traditional control technology approaches.

Environmental management research is directed toward improving the capabilities of state, regional, and local governments for instituting and managing environmental programs by providing them with improved information and methods for identifying and describing alternative solutions to specific environmental problems and for selecting and implementing the best solution.

The program considers four fundamental functions performed by public administrators: planning, evaluation, implementation, and enforcement. It emphasizes intermedia and secondary effects of environmental management actions, implementation incentives and institutional arrangements, and consideration of the complete range of implementation measure, including economic incentives, land use management measures, and public education programs, as well as the traditional regulatory mechanisms.

The management of parking spaces in urban areas as an incentive to reduce the use of automobiles is an example of a nonstructural approach to mobile-source emission control. Such an approach, while simple in theory, can be ineffectual if the social, psychological, institutional, and economic aspects of the proposed program are not considered and included in the plan. This report stresses these aspects of parking management planning, and places less emphasis on the computational aspects of determining actual reduction of vehicle-miles traveled, which are presented in detail in references listed in the bibliography.

ABSTRACT

This report defines the concept of parking management and explores how parking management can be used to improve air quality, support mass transit, reduce energy consumption and improve the amenities of life in urban areas. Specific aspects of this analysis were developments of a prototype parking management plan for the Washington, D.C. metropolitan area illustrating types of measures which can be used for parking management; evaluation of the socioeconomic impacts of parking measures in the plan and their effectiveness in reducing vehicle miles traveled (VMT) and improving air quality; development of a parking management planning process which integrates local and regionwide planning through the use of regional guidelines.

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CHAPTER I

SUMMARY

A. Goals of the Study

This study seeks to define the concept of parking management and explore how parking management can be used to improve air quality, support mass transit, reduce energy consumption and improve the amenities of life in urban areas. Specific goals of this study are:

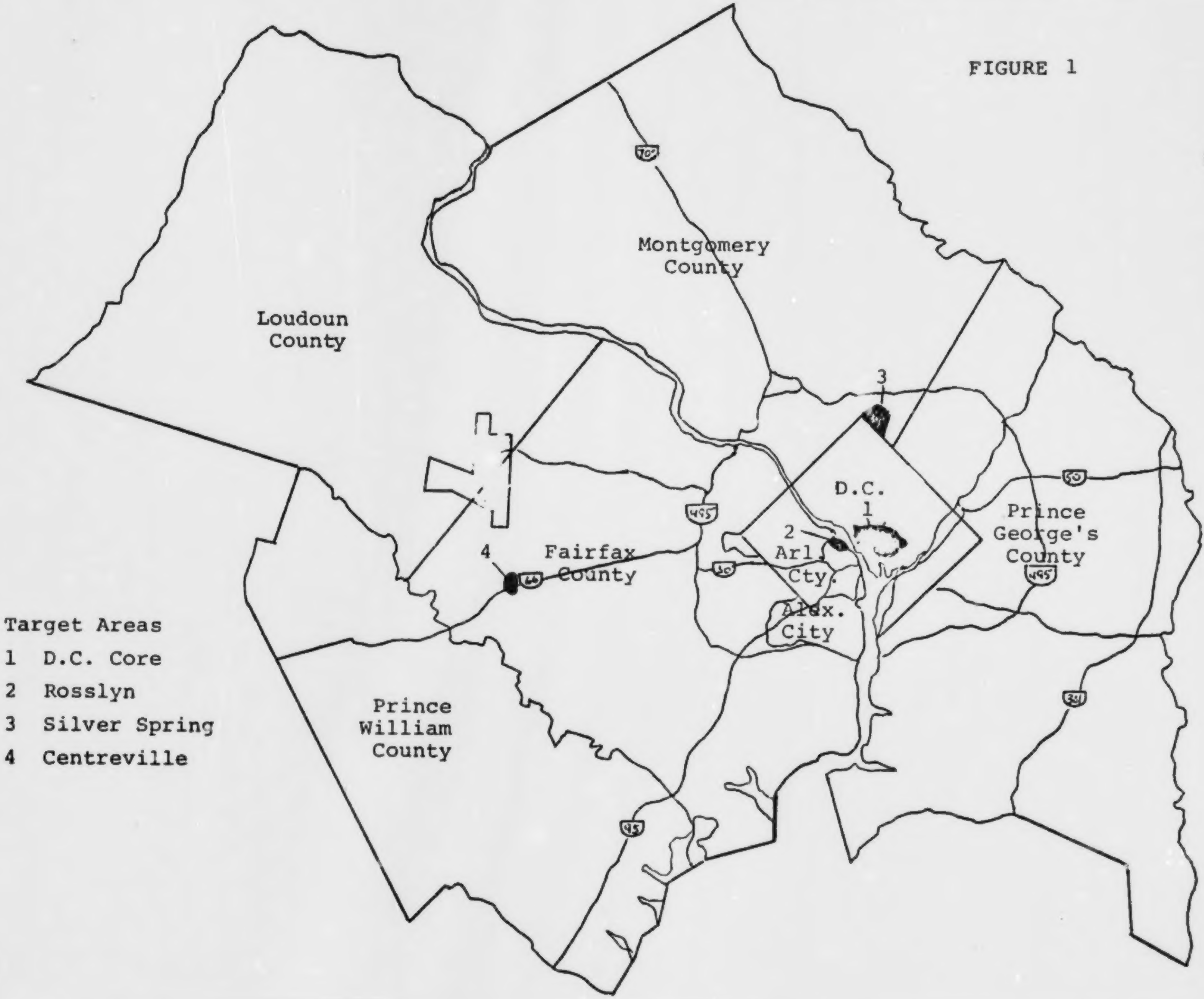
- to develop a prototype parking management plan for the Washington, D.C. metropolitan area illustrating types of measures which can be used for parking management;
- to evaluate the socioeconomic impacts of the parking measures in the plan and their effectiveness in reducing vehicle miles traveled (VMT) and improving air quality;
- To develop a parking management planning process which integrates local and regionwide planning through the use of regional guidelines.

Four target areas in the D.C. region were studied in detail (Figure 1): the D.C. Core, Rosslyn, Va., Silver Spring, Md., and Centreville, Va. A regional plan was then developed from information gathered in the target area studies, including an analysis of regionwide parking related goals and problems.

B. Definition of Parking Management

Parking management is a relatively new concept designed to redress policies of unrestrained support of automobile use in favor

FIGURE 1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4
Target Areas
1 D.C. Core
2 Rosslyn
3 Silver Spring
4 Centreville

of a more balanced approach to transportation which includes mass transit, carpooling, walking and bicycling. Parking management is a process as well as a plan, a strategy as well as a specific list of parking measures. It requires political commitment, institutional coordination and a defined planning process with articulated goals and public involvement as well as technical analyses.

Over the short term, parking management cannot be effective without improved public transportation. Over the long term, parking management policies can affect land use decisions and ultimately the shape of urban growth to decrease the use of the automobile.

C. A Parking Management Plan for the Washington D.C. Area

Insufficient time and resources were available to develop detailed plans for all portions of the D.C. area, an effort which should properly be done by local governments acting in conjunction with regional transportation, land use and air quality planners.

Alternatively, four major types of parking strategies were identified as applicable to the region. The four strategies and the potential reduction in auto-driver trips which might be expected from them are given in Table 1. Table 2 shows these trip reductions as a percentage of total trips. The calculations are explained in Chapter VII. The proposed strategies are delineated below.

1. Residential Parking Permit Systems and Removal of On-Street Commuter Parking

These measures will preserve the integrity of residential neighborhoods from overflow commuter parking and restrict the access of commuters to free parking, thus effectively raising their parking rates and diverting them to transit or carpools. It also will improve traffic flow. These measures must be implemented before

TABLE 1

ESTIMATED IMPACT OF PARKING MANAGEMENT STRATEGIES*

	Auto Driver Trip Reduction		
	Without Additional Constraints	by 1980	by 1990
1. Residential Permit Systems and Limits to On-Street Commuter Parking	2,000	14,500	14,500
2. Parking Price Increase and Preferential Carpool Parking	24,500	46,000	46,000
3. Transit Support Through** Additional Park 'n Ride Lots for Buses	9,000	13,800	22,000
4. Zoning and Land Use Controls	---	---	185,000
TOTAL	35,500	74,300	267,500

* The numbers presented here are only intended as indicators of parking management impacts. Due to the nature of these strategies, such numbers cannot be rigorously derived. The numbers reflected impacts on commute trips plus associated non-home based trips.

** Planned Metro lots will accommodate 30,000 automobiles but are not credited as a parking management measure.

parking rates can be increased so that the free parking option is eliminated. Regional guidelines would provide model ordinances and set criteria for determining the types of neighborhoods where the ordinances would apply. These measures together could reduce auto driver trips by 14,500 by 1990.

2. Increased Parking Rates and Preferential Carpool Parking

Parking is heavily subsidized by employers (both private and government), by building rents, by businesses and by local communities. As a result, commuters pay only about half the real cost of parking. If subsidies were reduced, the cost of auto driving will increase, diverting commuters to transit or carpools. In conjunction with improved transit and carpooling incentives, this measure could potentially eliminate 46,000 auto driver trips in the D.C. area by 1990. Regional guidelines would suggest potential ways to raise parking rates through voluntary reductions of employer subsidies, restrictions on parking supplies to allow gradual rate increases, and imposition of parking taxes or selectively applied surcharges.

3. Transit Support Through Park 'n Ride Facilities

Two parking considerations are critical to the success of bus and rail mass transit:

- restrictions of parking supply at major employment centers which raise parking prices and increase transit demand;
- provision of adequate parking at transit stops outside the Core to intercept auto commute trips and make transit more accessible.

The first consideration was addressed by strategies 1 and 2. By 1990, these two strategies could reduce daily auto driver trips by 60,300 and increase transit trips by 17,000. Park 'n ride lots for express buses and outer rail stations will also increase transit ridership. Currently planned bus and rail lots will eliminate 90,000 auto driver trips by 1990 while additional park 'n ride facilities could eliminate another 13,000 trips.

Together, the measures suggested in the regional plan will increase transit ridership by 20,700 by 1980 and 123,000 by 1990.[1/] These riders would contribute about $10 million per year in additional transit revenue by 1980.

Regional guidelines will support mass transit by allocating fringe and rail station parking to each jurisdiction based on such factors as population, transit service, income and travel patterns. This would help guarantee adequate parking supply in the face of considerable citizen opposition to additional parking at Metro rail station sites.

4. Zoning and Land Use Controls

Zoning and land use controls influence both parking supply and demand. Zoning codes may artificially inflate parking supplies by requiring that developers construct at least a set number of spaces. Where mass transit is available, zoning requirements could instead impose maximum limits on the number of spaces allowed. Alternatively, they could set a minimum of zero spaces and let builders determine the appropriate parking supply, or they could require a parking analysis, similar to an environmental impact assessment, for new construction.

1/ Assumes an occupancy rate of 1.4 persons per car and diversion of 33% of all auto drivers and passengers affected by the measures. For trips to the Core, the diversion rate to transit is assumed to be 56%.

Parking demand, on the other hand, is largely determined by land use plans which influence the demand for automobile trips and parking. Mixed use zoning can reduce parking demand by combining residential and employment areas, thus reducing the need for long commute trips.

By 1990, auto driver trips would be reduced by 185,000 if land use plans in the Washington, D.C. area became more transit-oriented, and parking supplies are reduced through changes in zoning codes. Regional guidelines to reach this objective would recommend general growth patterns, suggest model zoning codes and require parking impact analyses.

5. Summary

As noted in Table 1, these strategies can be ranked in terms of their effectiveness as follows:

1) Zoning and Land Use Controls
2) Rate Increases and Preferential Carpool Parking
3) Transit Support Through Park 'n Ride Lots
4) Residential Permit Systems and Commuter On-Street Bans

Long term measures are by far the most effective and least painful. They involve basic changes in growth patterns toward more "transit-effective" land uses. Rather than rapidly changing existing patterns, long term measures gradually alter the urban infrastructure so that it supports transit rather than auto commuting.

D. Major Findings of the Study

Data gathered in the target area studies and evaluation of the regional plan for the Washington, D.C. area supports the following major conclusions concerning the parking management planning process and the impacts of the plan.

General Findings

1. Parking management can be an effective means of reducing automotive air pollutants only if there is a large volume of easily divertable, concentrated (i.e. home-to-core) traffic.

2. Parking management will become a less effective means of reducing automotive pollutants on an absolute basis as the average emission rate for the population of cars is lowered through improved engine design and emission control devices, i.e., eliminating a vehicle-mile traveled by a "clean" car reduces pollution less than a similar VMT reduction for an older "dirty"car.

3. Parking management has significant energy conservation and congestion-reduction benefits through VMT reduction irrespective of the pollutant emission characteristics of the auto population.

4. Parking management measures must be carefully timed to coincide with improvements in mass transit. Unless this is done, the measures will cause severe economic dislocation in certain areas and as a result will be politically difficult or impossible to implement.

5. Parking measures can have diverse social and economic impacts on various areas within a region depending on each area's economic health and attractiveness, stage of development, and mix of land uses. For this reason, measures must be carefully tailored to local conditions in each community of a region. For example, parking supply restrictions in Rosslyn would not have adverse economic impacts while the same measures in Silver Spring could damage its potential for economic growth.

6. Parking in the Washington, D.C. area is heavily subsidized by the Federal government and by many local governments. This conflicts with the publicly expressed goals of diverting people from automobiles to reduce congestion, conserve energy, improve air quality and support transit. Federal parking accounts for 25 percent of all Core area parking and costs an average of $9 per month as compared to $20-$60 per month in commercial spaces. An increase in Federal parking prices to $40 per month would increase Federal revenues by $ 14 million. Legal barriers may exist to raising Federal rates and using the additional revenue for transit support.

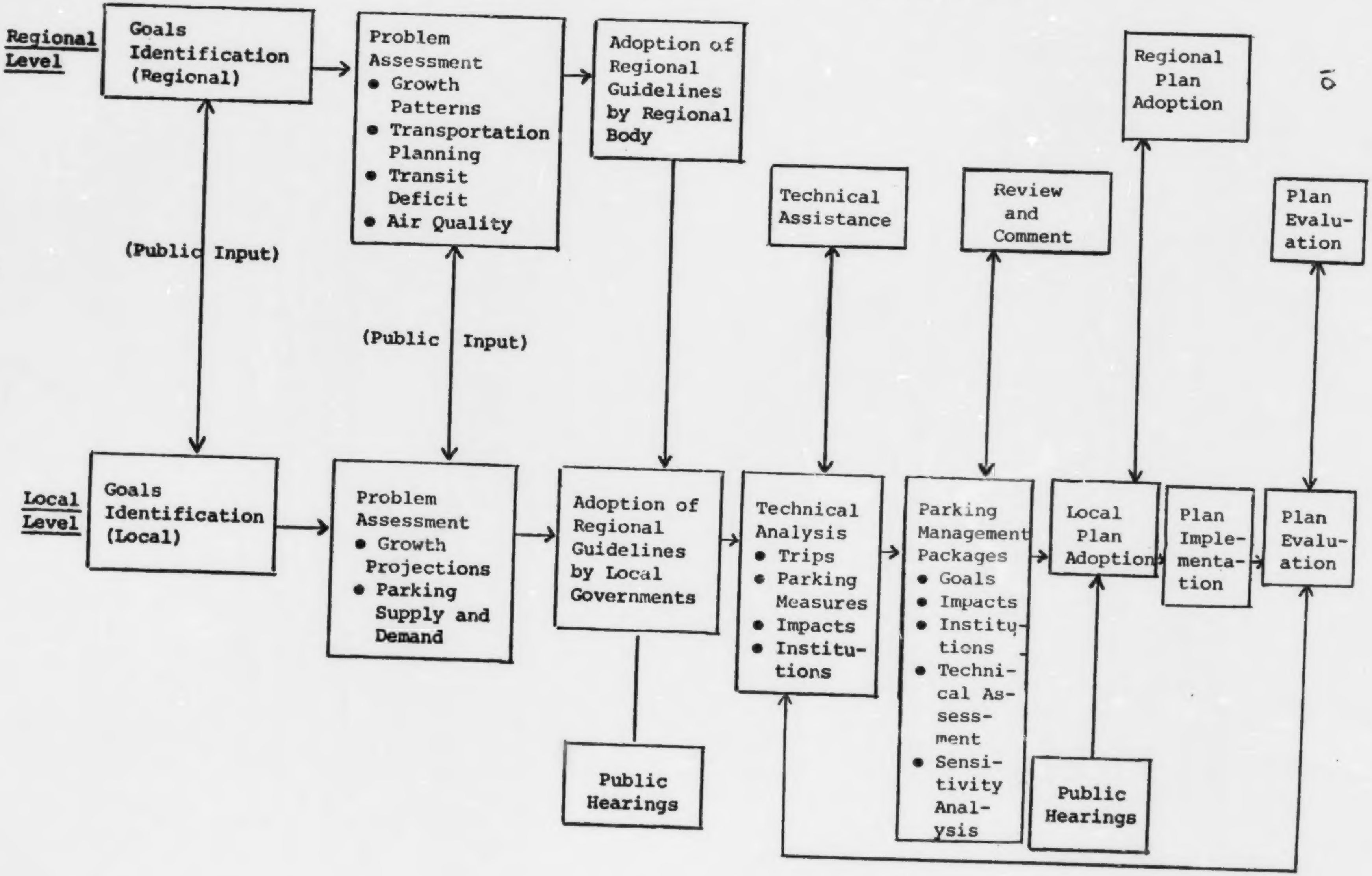
7. Private employers frequently subsidize employees' parking. In addition, office rents often pay part of the development costs of garage facilities. If parking rates reflected the economic value of development and land costs, average parking prices could double, deterring the use of single passenger automobiles where lower cost transit is available.

8. Developers, office building tenants, and indirectly consumers bear the substantial costs of building parking facilities. The proposed parking measures would reduce new parking supply in the D.C. Core, saving up to $ 30 million annually in development costs by 1990.

9. Regional coordination is needed in parking management planning to achieve such regional goals as the support of mass transit, the improvement of air quality, and the reduction of congestion. However, local governments should retain the responsibility for detailed planning and implementation of parking measures to fit local needs. A proposed local/regional planning process is diagrammed in Figure 2 which incorporates regional guidelines developed through a regional coordinating body, to which local parking plans should correspond.

FIGURE 2

LOCAL/REGIONAL PLANNING PROCESS FOR PARKING MANAGEMENT


Regional Level
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Problem Assessment
• Growth Patterns
• Transportation Planning
• Transit Deficit
• Air Quality
Adoption of Regional Guidelines by Regional Body
Technical Assistance
Review and Comment
Regional Plan Adoption
Plan Evaluation
(Public Input)
(Public Input)
Local Level
Goals Identification (Local)
Problem Assessment
• Growth Projections
• Parking Supply and Demand
Adoption of Regional Guidelines by Local Governments
Technical Analysis
• Trips
• Parking Measures
• Impacts
• Institutions
Parking Management Packages
• Goals
• Impacts
• Institutions
• Technical Assessment
• Sensitivity Analysis
Local Plan Adoption
Plan Implementation
Plan Evaluation
Public Hearings
Public Hearings

Findings Related to the Parking Plan for the D.C. Area

1. The parking management measures proposed for the D.C. area would significantly reduce auto-driver trips. It is estimated that 267,500 auto-driver trips per day could be eliminated through parking management by 1990. Assuming 1.4 persons per car, 374,500 person trips daily would be eliminated which compares with an existing daily Metrobus ridership of 400,000-450,000. Table 2 shows the percentage reductions in commuter and non-home-based trips due to parking management measures for 1980 and 1990.

2. By 1980, 74,300 auto driver trips should be eliminated diverting approximately 20,700 people to Metro rail or bus and increasing Metro revenues by approximately $10 million. This would substantially reduce the $102 million transit deficit which local governments will be expected to absorb. By 1990, after completion of the rail system, parking management measures could add 123,000 riders and $60 million in revenue which could allow Metro to generate an operating profit.

3. The 267,500 auto-driver trips per day eliminated by parking measures will have more impact on transit ridership, carpooling, and the reduction of congestion than on air quality. By 1990, they are estimated to reduce pollutant emissions less than 2 percent. While this figure may appear small in an absolute sense, it must be kept in mind that by 1990 automobiles on the road will be "clean" automobiles and stationary source controls will have eliminated much of the remaining automobile related pollutants. All other remaining automobile control measures including parking management will, therefore, not show large percentage pollutant reductions but may still be necessary to achieve the primary standards as well as show the energy savings and quality of life benefits.

TABLE 2

PERCENTAGE REDUCTIONS IN AUTO USE DUE TO PARKING MANAGEMENT

	Percent Trip Reduction			
	1980		1990	
	Commute	Non-Home based	Commute	Non-Home based
Existing Measures	2.0%	1.5%	1.4%	1.0%
Proposed Parking Use Measures	1.7%	1.6%	1.2%	1.1%
Proposed Zoning and Land Use Measures	--	--	6.2%	4.2%
TOTAL	3.7%	3.1%	8.8%	6.3%

4. The most valuable measures in reducing auto-driver trips were long range measures including zoning modifications and land use controls. These measures are relatively painless because they result in gradual lifestyle adjustments caused by more transit-oriented growth patterns.

E. Sensitivity of the Analysis

Estimates of parking supply and demand, area growth patterns, changes in the modal split etc., are precarious at best. EEA numbers are only intended as indicators of the relative effectiveness of various measures and the order of magnitude impact of the proposed parking management planning process. Some of the study's findings about the effectiveness of parking management, however, could be altered by changes in several assumptions.

While proposing measures that are more stringent than those that local commuters would choose without outside influence, the study accepts local jurisdiction goals. If implementation is not a local function, then much more stringent measures could be utilized. However, EPA experience indicates that local goals must be given more, not less, consideration if parking management is to succeed.

The study concentrated on the home-to-work trip as the one most easily divertable to transit by parking management; although one non-home-based work trip was eliminated for every two home-to-work trips diverted. While other trips could be affected, the problem remains that only 7 percent of all auto-drivers trips are home-to-core work trips (those most easily divertable). And, with the addition of emissions controls, autos will be accounting for a smaller proportion of air quality problems. Consequently, realistic changes in the proposed approach are unlikely to dramatically change the conclusions about air quality impacts.

Modal splits developed by WMATA were used, except where better data could be developed. Failure to achieve the projected diversion to transit would increase parking demand and probably improve the effectiveness of the proposed plan in terms of auto-driver trips reduced. However, the number of auto-driver trips diverted to transit as opposed to carpools would probably decline. Consequently, the impact on transit deficits could become less significant.

The qualitative conclusions are relatively insensitive to changes in the study's assumptions. The conclusion that parking management planning can play a significant role in reducing reliance on the automobile for commuting will be supported under almost any assumption. The quantitative conclusions, air quality improvement, transit deficit reductions, energy savings, etc., are sensitive to changes in the assumptions. However, to further refine these calculations at this time would be of little value in developing a parking management planning process.

F. Possible Future EPA Roles

In the future, EPA can take several approaches to parking management. EPA's dilemma is that it is the agency responsible for protection of the public health from automotive pollution. However, parking management cannot succeed without support from the transportation establishment. Potential roles that the Agency might assume include the following:

- Stipulations in Amendments to the Clean Air Act that cities with severe air quality problems must accomplish a parking management planning process that incorporates certain parking management measures. For example, most polluted cities might be required to incorporate vehicle free zones, lower rates for short-term parkers, commercial rates and maximum rather than minimum zoning criteria (parking spaces/square feet). Cities violating health standards but not by much would be required to incorporate less strenuous parking management measures such as on-street parking bans and fast bus lanes. EPA's role could involve the review and approval of the process and measures.

- EPA would be authorized to fund local and regionwide planning agencies in parking management planning and implementation. In most cases, this funding would be in conjunction with DOT and/or EPA's Section 208 (water) planning efforts.

- EPA could be given the authority to approve or disapprove parking planning in conjunction with applications for UMTA transit grants for those cities and associated measures stipulated in the first solution above.
- EPA could have review authority with regard to the annual transportation planning process, particularly the determination of consistency. In other words, for the cities and measures specified in the first solution above, EPA could disapprove transportation plans that did not meet the parking management requirements stipulated pursuant to the first solution above.

CHAPTER II

INTRODUCTION

A. Objectives of this Parking Management Study

The purpose of this study is to develop an example parking management planning process for the Washington, D.C. area, which is also applicable to other areas. The study will provide:

- a definition of parking management;
- the explanation of a parking management process that communities can use to develop parking management plans including the development of institutional approaches to achieving, in concert, regionwide and community goals;
- illustrative case studies at the community level which show how communities should relate to regionwide institutions and how reliable technical analyses can be accomplished;
- a prototypical parking management plan for the D.C. area which, while it is not geographically complete, nor in all respects technically at the state-of-the-art (due to resource and time constraints), does provide users with an example framework for a regionwide plan and handbook guidance on how to prepare a complete plan.

B. Assumptions

This study includes a number of assumptions which may limit the applicability of its conclusions. The most important assumptions are:

- This study accepts local jurisdictions' goals as expressed in interviews and planning documents. However, the stringency of proposed measures often exceeds what communities would choose without outside influence.
- The bus and rail transit system will presumably be developed and completed by The Washington Metropolitan Area Transit Authority (WMATA) as planned.
- WMATA's estimates of modal split to transit in 1980 and 1990 are accepted, except where alternative projections are noted.
- The study concentrates on the home-to-work trip as the one most easily diverted to transit by parking restraint measures. One non-home based work trip was presumably eliminated for every two home-to-work trips diverted.
- It is assumed that in the core, 55 percent and elsewhere 35 percent, of the people diverted away from auto-commuting by parking management measures will make the trip by transit. The remainder will use carpools.
- While parking management planning may be shared by local and regional governments, implementation will remain a local function.

C. Background

This study develops a parking management process which, when carried out in a coordinated manner by local and regional government agencies, results in a parking management plan that realistically reflects what can be implemented. Realism in this context means a plan which reflects meaningful local and regional community goals.

Under the Clean Air Act, states were required to submit implementation plans by January 30, 1972 containing strategies demonstrating how national ambient air quality standards would be achieved by 1975, or in selected difficult cases by 1977. EPA encountered serious problems in metropolitan areas where vehicle emission controls were not sufficient to ensure the attainment of the standards.

In response to a court action precipitated by the Natural Resources Defense Council, EPA agreed to develop plans to reduce traffic in twenty-nine metropolitan areas. A delay was granted until February 15, 1973 to study and then select a combination of transportation controls including carpooling, mass transit usage and motor vehicle restraints to reduce emissions. Ultimately, plans for these twenty-nine areas were finalized in late 1973. However, EPA was primarily responsible for development of these plans because there was little time to obtain local input.

Parking management was an element in nineteen of the transportation control plans (TCP). It was defined solely in terms of the inclusion of parking measures such as on-street parking bans, the imposition of commercial parking charges in lieu of subsidized parking, and vehicle free zones. Considerable resistance to implementation of TCP measures was encountered and the parking management portions of most TCP's were ultimately withdrawn or delayed indefinitely. Congressional action and other difficulties have precluded further EPA efforts to implement parking management as a part of transportation control planning, however, the need for action to improve air quality in cities like Washington, D.C. remains.

The concept of limiting the supply and controlling the price of parking remains a method for reducing reliance on the automobile and improving air quality. Additional benefits flow from this approach including the aesthetic improvements in areas free of auto traffic, reduced congestion, less noise, and improved energy efficiency. The purpose of this research effort is to develop the concept of parking management further in an effort to define it more precisely. This is important because it is possible that EPA's failure to implement parking management is largely a failure to develop the appropriate institutional arrangements. This possibility is abundantly illustrated by the Washington, D.C. experience. Washington's parking management plan was technically a well-developed document. Unlike most parking management plans, it was primarily a non-EPA product. The approach proposed by EPA in late 1973 was almost wholly developed by the technical staff of the areawide (D.C., Maryland and Virginia) Council of Government's staff. The chief provision of the parking management plan was a measure to eliminate subsidized parking throughout the central core and the densely populated non-core centers. For those areas adequately serviced by the new $4.5 billion Metro mass transit system, an additional parking surcharge was to be imposed to provide an incentive for increased mass transit utilization.

After a lukewarm reception by the local newspapers, the D.C. plan met increasing opposition. Finally, the Congress withdrew EPA's power to implement the key parking charge provision. Reflecting on the two years of effort by local communities and the COG staff, the leading COG staff official responsible for developing the D.C. area parking management plan could say in March 1975 that "while we worked on this project for two years, even today we do not know what parking management is." This astonishing statement has several possible consequences. Perhaps EPA knew but the community did not understand;

Or, perhaps there is no technical basis for believing that parking management can reduce automobile use and thereby improve air quality. Neither of these explanations is likely. Much more probable is that EPA and COG viewed the development of parking management as a technical task, whereas above all it is a political and institutional effort.

A hypothesis underlying the development of this project is that a flaw in the D.C. parking management plan was its lack of grassroots institutional support. Communities had not focused on parking management and identified their goals as consistent with it. Institutions were not developed which could serve as community focal points for goal setting, conflict resolution, and on-going technical analysis. Evidence to support this hypothesis is abundant. Communities in the D.C. area do not feel responsible for the plan, nor did they have a large role in its development. The plan is homogenous across the entire 2.8 million population region whereas the economic situations of the communities vary, their access to mass transit is different, and their political objectives are diverse.

Part of the difficulty with parking management in the D.C. area can be attributed to time and resources. Months, not years, were available to develop a plan, yet institutional understanding and technical knowledge were practically non-existent. Few Federal or local resources were available. The fact that proposed amendments to the Clean Air Act in the House and Senate would provide millions of dollars to build and support such institutions indicates the institutional obstacles to parking management are being recognized.

D. Definition of Parking Management

1. Overall Purpose

Parking management is a new concept related to the broader issue of managing automobile traffic in cities in a manner to achieve a better balance between automobile use on the one hand, and public transit, car pooling, bicycling and walking, on the other. It is a new concept because historically the provision of parking supply in U.S. cities has been keyed to the objective of maximizing the supply of parking in relationship to demand. Parking supplies have only been constrained by the willingness of employers and business to pay for the cost of providing spaces to workers and shoppers. The evidence is abundant that many commuters pay far less than commercial rates for parking. One survey in the District of Columbia found that 56 percent parked free and over 80 percent paid $1.00 per day or less.[1/]

If public policy shifts in favor of a transportation policy balanced among modes, recourse must be taken to one or several methods of increasing the cost of automobile travel.[2/] A gasoline tax is one approach, but it has little political appeal. It is also indiscriminate in application, impacting all drivers. Bridge tolls are another alternative with many advantages, but in the District of Columbia tolls are unpalatable because of jurisdictional differences which resist a "commuter tax." Another possible automotive restraint is congestion itself.

1/ See G. K. Miller and K. M. Goodman, "The Shirley Highway Express-Bus-on Freeway Demonstration Project--The First Year Results," UMTA, November, 1972

2/ Of course non-automotive modes can be subsidized but experience has shown that even with substantial public transportation subsidies, high transit ridership is difficult to attain.

Even with abundant parking, great congestion can increase driving times to the point that public transportation will be favored. However, congestion has drawbacks: it worsens pollution and ties up buses as well as cars. By the process of elimination one is led to parking management.

2. Parking Management - What is it?

Parking management encompases all policies that attempt to tailor the supply of parking to demand so as to increase the price and scarcity of parking in order that automobile drivers have an added incentive to shift to other modes or at least car pool. Among the list of parking management tools are the following:

- strict enforcement of parking meter conditions and time limits for on-street parking spaces;
- residential sticker systems to give priority access to residents over lower priority uses such as commuter parking;
- park'n ride and kiss'n ride facilities for public transportation;
- maximum parking space limits per square foot of newly constructed floor space instead of the currently prevailing minimum limits;
- higher rates for off-street parking, including application of "commercial rates" to currently subsidized parking;
- altered parking rates to make short-term parking cheaper relative to long-term parking to favor shopping trips over commute trips;
- ceilings on new parking space construction including moratoria on parking construction;

- on-street parking bans to facilitate vehicle flows, particularly bus service; and
- vehicle free zones to open street areas to serve as in-town shopping centers.

3. Selectivity

The chief advantage of parking management as a vehicle restraint approach is its selectivity. In a particular community in need of commercial revival, without expanding the supply of parking the price of short-term shopper parking can be reduced and all-day prices can be increased to attract shoppers and shift commuters to public transit. If, as is the case in Washington, D.C., it is desired to provide parking at the outer fringe of the new public transit system while reducing it at the down-town terminus, parking management can be applied to the appropriate Metro-served areas.

4. Limits on Parking Management

In the short run, the ability of a community to manage parking to restrain automobile use is limited by the capacity of available transit systems to pick up the diverted automobile traffic without undue cost or inconveniences to the travelers. In other words, parking management must go hand-in-hand with improved public transportation.

In the long run, parking management can be employed in conjunction with land use planning to help alter the shape of cities. If growth takes place at nodes or housing-office complexes where work opportunities and residences are co-located, then reduced parking spaces per capita can help insure that growth does not sprawl unnecessarily.

It is difficult to envision the consequences of long-range application of land use patterns intentionally designed not to be automobile-dominated. Coordinated application of land use and zoning practices with parking management and augmented transit in Washington, D.C., for example, would take at least a decade to yield a discernably different land use pattern. However, a North American city of similar size to Washington, D.C. opted for transit dominance about the same time Washington, D.C. was encircled by the Beltway, symbolic of its commitment to the automobile. The results are summarized in Table 3 below.

TABLE 3

1973 Comparative Data on Washington, D.C. and Toronto, Canada

	Washington, D.C.	Toronto
Population	2.9 million	2.8 million
Area	257 sq. miles	240 sq. miles
Fixed Rail Transit Miles	0	100
Transit Trips Per Day	199,000	600,000

Toronto is widely acclaimed as one of the most liveable modern western cities. For over a decade, Toronto's growth has been shaped around public transit. Special parking has been provided near transit stations and downtown parking has been limited. One consequence, for a city smaller than Washington, D.C. by about one-fourth and of a lesser population density, is a three-fold higher transit ridership.

Ultimately, the 98 mile Washington, D.C. Metro system in conjunction with buses is projected in the 1990's to carry 1.2 million riders. This can only be accomplished if supportive land use and transit policies are adopted.

5. Goals and Institutions

Accomplishing parking management planning is in large part a political and institutional task. Technical brilliance cannot substitute for community commitment to a revised role for the automobile. Previous efforts by EPA to implement parking management have consisted largely of the mechanical application on a regionwide basis of the parking management tools described earlier. This report develops an alternative approach. Its emphasis is on harmonizing regionwide and community goals. Only at the regional level can meaningful policies to improve air quality, operate public transit systems, coordinate major highway transportation and save energy through travel reductions be adopted. Likewise, some regional-level coordination is necessary to avoid economic inequities among communities if some impose parking management controls and others do not; alternatively, regionwide coordination is key to insuring that economically troubled communities are not damaged by parking measures adopted without concern for the local economy. Yet only at the community level (25,000 to 150,000 people) do all considerations that bear on parking supply and demand converge. These include the essential needs for residential and shopping parking. Likewise, only at the community level are zoning and parking ordinances employed as part of land use planning and only at the community level does day-to-day policing of parking take place.

E. EPA's Role

1. From Facility-by-Facility Reviews to Parking Management Plans

EPA's indirect source and parking management efforts have been suspended despite considerable effort to develop a viable strategy. First, in 1973 controls were to be implemented to reduce carbon monoxide pollution near new parking facilities of 1,000 spaces or larger in SMSA's and 2,000 spaces or larger in non-SMSA communities. These requirements were part of the indirect source regulations. Later in 1973 EPA proposed that nineteen cities particularly troubled by automobile pollution, implement a more elaborate parking management approach. This approach applied to new parking facilities larger than 250 spaces. It was a separate parking facility review regulation that took shape as part of EPA's efforts to finalize transportation control plans in major U.S. cities. Those who proposed to build parking facilities in these cities had to demonstrate that the traffic attracted to their lots would not cause a carbon monoxide problem. They also had to demonstrate that their facility would not "generate" additional travel. If new facilities attract automobiles from long distances, the areawide vehicle miles traveled (VMT) can increase. Increased VMT results in greater hydrocarbon and nitrogen oxides emissions. These pollutants are decisive factors in smog formation.

In the second version of these parking regulations, proposed in August 1974, EPA shifted its emphasis from carbon monoxide pollution in the immediate vicinity of parking sources and began to give primary concern to the problem of reducing areawide VMT. These proposed regulations made another critical distinction: EPA introduced the concept of parking management plans. Previously EPA had emphasized facility-by-facility reviews. In short, any builder of a parking facility of 250 spaces or larger in the designated city had to apply for a permit and be dealt with as a single facility. The applicant was supposed to show efforts to link his facility with mass transit. The proposed regulations required him to post bus schedules, seek bus route modifications, and consider installing park-and-ride lots and transit shelters and possibly implement a para-transit program. If the applicant wanted to avoid these requirements he had either to show his facility was a park-and-ride lot or complete a study showing that the net effect of his facility would be to reduce VMT because it diverted longer trips to more distant facilities to itself.

The new August 1974 EPA thrust accompanied the facility-by-facility requirement with an alternative called a parking management plan (PMP). If a city developed a master plan for its parking facilities, showing such things as where growth in spaces would be balanced with curtailments, then EPA would forego the detailed facility-by-facility review.

Before EPA suspended its parking management program on July 1, 1975, it had planned to put out yet a third set of parking management regulations. These would have further emphasized the PMP concept by spelling out more precisely how a city should prepare a PMP. Facility-by-facility reviews became the "stick" to prod communities to develop PMP's.

The Federal Executive Branch is now opposed to Federal intervention on a facility-by-facility basis. It is believed that States and localities should handle such things. Current draft amendments to the Clean Air Act pending in Congress lean toward the same philosophy. This attitude leaves unanswered the question of sanctions. What if the States and localities do not act to complete PMP's? Two approaches are under consideration to add credibility to the concept of local performance. One is to provide the carrot of 100 percent federal funding to local agencies that complete PMP's. Of course a plan is not necessarily a regulation. To insure that regulatory action is taken others are advocating that cities that need but will not prepare PMP's be denied Federal funding for such items as highways, mass transportation, and sewage treatment facilities.

Congress could politically remove the irritant of parking management by funding local agencies to prepare plans, but with no guarantee or sanction for local performance. Alternatively, Congress could require the preparation of PMP's coupled with the sanctions of either withdrawal of Federal funding for selected projects or Federal intervention and preparation of PMP's in the absence of State and local performance.

2. Possible Future EPA Roles

In the future, EPA has several approaches it could take to parking management. EPA's dilemma is that it is the Agency responsible for protection of the public health from automotive pollution. However, parking management cannot succeed without support from the transportation establishment. One solution would be to do the following:

(a) Stipulate in Amendments to the Clean Air Act that cities with severe air quality problems must accomplish a parking management planning process that incorporates certain parking management measures. For example, most polluted cities might be required to incorporate vehicle free zones, lower rates for short-term parkers, commercial rates, and maximum rather than minimum zoning criteria (parking spaces/ ft^2). Cities violating health standards but not by much would be required to incorporate less strenuous parking management measures such as on-street parking bans and fast bus lanes.

(b) EPA would be authorized to fund local and regionwide planning agencies in parking management planning and implementation. In most cases this funding would be in conjunction with DOT and/or EPA's Section 208 (water) planning efforts.

(c) EPA could be given the authority to approve or disapprove parking planning in conjunction with applications for UMTA transit grants for those cities and associated measures stipulated in (a) above.

(d) EPA could have review authority with regard to the annual transportation planning process, particularly the determination of consistency. In other words for the cities and measures specified in (a), EPA could disapprove transportation plans that did not meet the parking management requirements stipulated pursuant to (a).

CHAPTER III

ALTERNATIVE PARKING MANAGEMENT PLANNING PROCESSES FOR A REGION

The institutional process chosen for parking management planning in an interstate, multi-jurisdiction metropolitan region such as Washington D.C. is critical in determining the success or failure of the parking management plan. Too much top-down regional control results in plans which are not implementable on the local level, while too great an emphasis on local planning can result in plans which do not address regional goals.

The planning process must be structured so that local governments' experience and sensitivity to parking needs is incorporated with a recognition of how parking can address regional goals of air quality, energy conservation, and support of mass transit.

The regional instrument in the Washington Metropolitan Area is the Council of Governments, together with its independent Policy Committees such as the Transportation Planning Board and The Air Quality Planning Committee. Although COG itself has no implementation powers, it has planning responsibilities in land use, transportation, air and water quality, and through cooperative agreements is able to develop policies and programs of a regional nature.

This chapter will explore the existing institutional structures available for parking management planning. Part A will show how parking management planning is carried out and implemented on the local level, noting the fragmented nature of such planning and its exclusive attention to local goals. Part B will look at existing types of COG programs, their coordination and output, including the potential of the "consistency" requirement for coordinating transportation and air quality planning. This will serve as a baseline for Part C, which will present and evaluate three options for parking management planning, resulting in a recommended planning process applicable to a large metropolitan area such as Washington.

A. Local Parking Management - Planning and Implementation

Parking is entirely a local government responsibility. Although no area jurisdiction has yet developed a parking management "plan" as such, the case studies indicate that all have distinct parking policies, whether or not they articulate and recognize them as parking policies. Also, local jurisdictions are increasingly aware that parking management involves more than simply providing parking to meet demand, as has been the case in the past. Nevertheless, most parking related efforts are still fragmented and uncoordinated on the local level.

Localities have many legal tools available to affect parking, some taken for granted and others subject to varying degrees of political and legal acceptance. Most local government parking powers are drawn from the "police power", delegated to localities by the States to protect the public health, welfare and safety. Under this legal umbrella, localities meter parking, enforce parking restrictions, levy fines and license and tax private parking lots. Under zoning powers, also derived from the police power, localities require minimum numbers of parking spaces in commercial, industrial and residential development.

These responsibilities for parking are shared by many different agencies within local governments, as shown in Table 4, and coordination is often inadequate. As a rule, the local transportation departments are charged by the governing council or board with both planning and implementation of parking measures. The comprehensive planning bodies are slowly becoming aware of the long range land use implications of parking management and are trying to integrate parking, transportation and land use planning.

It was noted that no air quality agencies had an active role in either planning or implementation of parking management programs.

TABLE 4

AGENCIES INVOLVED IN LOCAL PARKING

Type of Power	Planning Agency	Implementing Agency
Meter parking	Local DOTs	Police, meter maids DOTs
Prohibit on-street parking	Local DOTs	Police, meter maids DOTs
Set parking fines	Council, judges (in D.C.)	Police, court system
Operate public parking lots	Council, DOT	DOTs, police
Require license for private lots	Council	Licensing bureau
Place tax on private lots	Council	Assessments division
Set zoning requirements for spaces in new development	Council, Zoning Commission (in D.C.) planning boards & staff	Zoning Administrator

In addition to these accepted controls over parking, local governments have other potential controls where the legal authority and political acceptability are not yet firmly established.

- Residential parking permit systems: Montgomery County, Maryland and the District of Columbia are in the process of implementing permit systems, which are operational in Richmond, Virginia, Wilmington, Delaware, and Cambridge, Massachusetts. Arlington County's ordinance has been declared illegal and will probably be appealed. Details in these ordinances vary, altering their impact and, very likely, their susceptability to legal challenge.
- Rate control over private lots: Considerable uncertainty surrounds the question of whether a jurisdiction can exercise rate control over private lot operations. Possible means of doing this are to regulate parking as a public service, such as taxicabs, as has been contemplated in Arlington; tax parking lot operators so that higher costs would be passed through to the parker; or require adherence to a rate schedule as a condition of licensing. In theory, such rate control would be legal under local police powers, but most jurisdictions would have to seek specific state enabling legislation, for example to tax lots in Virginia. To date, no Washington area jurisdiction has attempted to directly control rates in private facilities.
- Parking Surcharge: The parking surcharge was a part of the original Transportation Control Plan for the Washington area and is considered legal as a State power under the Clean Air Act. While EPA can no longer require a surcharge, there is no legal reason why local governments

> could not do so, except that the surcharge idea is considered a politically dead issue by everyone. The major political problem with the surcharge idea in the Washington area is that it is considered a form of commuter tax by the city on suburban residents, even though suburban jurisdictions could impose it on themselves.

All local governments experience some fragmentation of their parking programs, but Washington D.C. is especially complex because of the predominant Federal presence in the city. Almost 25 percent of the parking spaces in the D.C. Core are under the control of either the General Services Administration or the Congress and thus not subject to any controls exercised by the city government under its home rule charter. Historically, these two parts of the Federal establishment have been less than cooperative in regulating their parking policies to meet city goals, especially in reducing their subsidy of employees parking costs.

Indirect controls over parking supply and demand, as opposed to the direct parking controls described above, are found in comprehensive land use and transportation plans and their associated zoning regulations. These affect the location and rate of development, the need for vehicle trips, mode of transportation available, and the number of parking spaces supplied by the private development. All jurisdications have such controls, but they are most fully used as a development tool in Rosslyn, in Centreville, and in Washington's West End.

A few parking programs presently transcend local control. Local governments have delegated to WMATA the responsibility for providing parking at Metro rail stations, but have retained a great deal of control over just how much parking will be developed at each station through veto power by jurisdictional representatives on the WMATA Board. As a result of local political pressures, the number of parking spaces at D.C. rail stations has been cut by 66 percent from those recommended in the original adopted regional system for Metro rail in 1968, and only the addition of 3,000 spaces at Shady Grove in Montgomery County has kept the total number of parking spaces equivalent to the originally planned total.

In addition, the Northern Virginia Transportation Commission (NVTC), has arranged free fringe parking for 1500 cars in lots to serve express bus routes into D.C. NVTC has no power of eminent domain to condemn land for fringe parking lots and little money to purchase them, so cooperative arrangements have been made with shopping center owners who have excess parking. In one case NVTC funds were used to repave an area for the owner, but usually the spaces are donated; COG and local funds are also used.

In summary, parking management on a local level is often uncoordinated, and responsibilities are scattered internally among numerous agencies. Few localities have incorporated parking management into either the transportation or comprehensive land use planning processes. In addition, no coordination exists among different jurisdictions in the region. As a result, most existing parking policies only match supply with demand for parking. Locally-oriented parking primarily concerns problems of traffic, local congestion and business needs. Consequently, parking programs tie closely to local goals, but not necessarily address the regional goals of transit maximization or quality and minimization of region-wide congestion.

B. Regional Frameworks for Planning

No significant regional effort has yet been made to carry out parking management planning in the Washington Area since the abortive efforts to include parking measures in the

Transportation Control Plans. The efforts of Washington COG in other regional planning efforts, however, are of interest in case a regional parking management planning process is undertaken. This section will describe and evaluate existing regional frameworks for planning as potential models for creating a regional parking plan.

Regional planning efforts now operate through Washington COG. COG is a voluntary, regional association of 16 local governments whose purpose is to coordinate actions of its members in matters of regional concern. COG functions through a Board of Directors made up of elected local officials from each jurisdiction, plus Federal and State legislators. COG is thus highly political and serves as a forum for the exchange of ideas rather than a regional governing body with either direct planning or implementation powers.

Certain regional planning efforts are, however, carried out by COG, its own Policy Committees, and Policy Committees associated with COG but independent of it, in the areas of transportation, air quality, land use and water resources. Table 5 summarizes the important characteristics of each of these planning processes, which are briefly described below.

- Transportation Planning: Carried out by the Transportation Planning Board (TPB) which was formed by interstate compact to do "cooperative, continuing and comprehensive" (3-C) transportation planning required under the Federal Air Highway Act of 1962. The TPB is composed of local government officials and representatives of transportation-related agencies including WMATA, DOT, and the State Highway and Transportation Departments. It functions as COG's transportation arm,

TABLE 5

COG ROLES IN REGIONAL PLANNING

	Authorization	Regional Agency	Funding*	Output	Coordination
Transportation	DOT Federal Aid Highway Act of 1962	Transportation Planning Board (TPB)	$1,220,000 from DOT and states for planning	3-C Transportation Planning Process, certified yearly by DOT prior to release of funds	Consistency Requirement to meet DOT Certification
Air Quality	EPA Clean Air Act of 1970 and amendments	National Capital Interstate Air Quality Planning Committee [illegible]QPC)	$190,000 from EPA plus local contributions	Recommends for SIP & TCP by states	
Water Resources	EPA Section 208	Water Resources Planning Committee (WRPC)	Coming from EPA	EPA approved regional plan	Potential coordination yet to be worked out
Land Use	HUD Section 701, Housing Act of 1954	COG-Land Use Policy Committee	$84,000 from HUD for planning	Revising Year 2,000 Plan for Region	

*Estimated 1976 COG Budget

uses COG staff, and prepares regional transportation plans for yearly certification by DOT as required before Federal funds can be released. DOT has required for 2 years that "consistency" be shown between transportation and air quality plans, a process which to date has satisfied no one although its potential is real for accomplishing this essential coordination. Newly issued Department of Transportation regulations[1] require that a Transportation Systems Management (TSM) element be included in all metropolitan transportation plans in order for projects to receive UMTA grant funds. Among the projects recommended for inclusion in the TSM element are parking management programs such as elimination of on-street parking, rate regulation, fringe parking and enforcement.

- Air Quality Planning: - Conducted by the National Capital Interstate Air Quality Planning Committee (AQPC) established by interstate agreement and associated with COG. The AQPC developed and recommended to the States portions of the State Implementation Plans applicable to the region and elements of the Transportation Control Plans. Composed of technical air quality personnel plus three COG members, the AQPC is less political than the TPB and thus less sensitive to local political realities, as demonstrated in the TCP planning process. As will be seen when regional planning efforts are evaluated, the lack of local political input and commitment to the TCP process was one of its greatest weaknesses.
- Land Use Planning: Carried out by a COG Policy Committee to recommend regional elements of land use to local governments, funded by HUD 701 monies. COG, however,

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[1] Part 450, Subpart A, 23CFR, Chapter I and Part 613, Subpart B, 49CFR, Chapter VI, issued September 17, 1975

has no power to alter local land use decisions, as this is the prerogative of local government.

- Water Resources Planning: Newly established by interstate compact under Section 208, the Water Resources Planning Committee must develop a regional plan for non-point source management for EPA approval. The regional planning process for this program is under development and it will be a number of years before its full impact will be realized.

None of the above models for regional planning meets the need for parking management, with the possible exception of the Water Resources approach which is yet to be proven. Some of the reasons for this are:

- Insufficient coordination between air quality and transportation planning. Parking management requires close coordination between air quality and transportation planning. DOT requires a finding of "consistency" between regional air and transportation plans, but this process has numerous weaknesses. Air quality agencies have not, in the past, been involved in commenting on long and short range transportation plans. The TPB has been reluctant to test any alternative plans other than the adopted plan, with and without certain highways, such as a plan which called for radically increased dependence on mass transit. In addition, there is no institutional mechanism for resolving inconsistencies between the two types of plans.

- Lack of requirement to do parking management planning. No funding lever exists in parking management, as it does in transportation where construction funds are contingent on satisfactory completion of a regional planning process, unless changes are made in the Clean Air Act. One potential requirement for parking planning is in the new DOT regulations. However, it is not yet clear whether adherence to these regulations will be required by the Washington area to obtain DOT funding for Metro rail construction. If so, a parking management plan could possibly be required.

- Lack of Funding: No federal funds are available to aid the region or localities in parking management planning at the present time.
- Local Institutional Problems: Particular institutional problems in the Washington area, such as the large Federal government presence, have complicated air quality planning as in the TCP and would likewise complicate parking management planning carried out under the same framework.
- Inability of any regional body to require Federal government cooperation in terms of air quality, particularly in reducing its parking subsidies to employees.
- Difficulty where air quality agencies plan for transportation-related measures, as in the TCPs, without full understanding of their impacts.
- Lack of political input into the AQPC because of its makeup, and lack of a mechanism for resolving differences between State governments which developed over air quality measures.

Despite these particular problems with existing planning processes, COG does have the potential for further regional cooperation. The AQPC is now undertaking an effort aimed at coordinating air, water, transportation and land use planning. A current study is investigating cooperation between the TPB and the AQPC and is being overseen by a joint committee of the two policy committees. Also, the consistency requirement is a potentially strong mechanism for requiring coordination between the TPB and the AQPC if fully utilized by both COG and DOT.

In summary the past two sections have shown that local parking planning is too locally oriented, internally fragmented, and not coordinated regionally to achieve regional goals of supporting mass transit, improving air quality and conserving energy. Also, that existing regional planning mechanisms have weaknesses, especially regarding coordination between air, transportation, and land use planning.

The basic question, therefore, is how to devise a structure through which parking management planning can work effectively to meet both regional goals and local needs. The following section will develop three basic alternatives for parking management planning to determine which would be most applicable for the Washington D.C. and similar large, metropolitan areas.

C. Three Approaches to Parking Management Planning

The challenge in parking management planning is to find a process which can incorporate the meeting of local needs with regionwide goals. Various strategies can be used to develop regional plans, specifically:

- The Grassroots Approach
- The Top-down Directive Approach
- The Regional Guidelines Approach

A fourth alternative is available where a strong regional government exists, as in Minneapolis-St. Paul, or where a metropolitan area is within a single state, and has few governmental subdivisions and a unified planning body. In this case, more responsibility could be given to the regional body and less local government participation required.

The following section will describe each approach and the planning process used, examine the output of the process, and evaluate its strengths and weaknesses, especially as demonstrated in the Washington Metropolitan Area. The major elements involved in each approach are shown in Table 6.

1. Grassroots Approach

This approach calls for local planning only and approximates the existing parking management planning process in most metropolitan areas. The characteristics of this planning process are a focus on local goals, little concern with the air quality aspects of parking programs and no regional coordination.

The rationale for this type of planning is that parking management involves land use decisions and policies which are local responsibilities and that parking measures have important local impacts, especially on the economic health of commercial areas and on a jurisdiction's ability to attract growth. Also, a grassroots approach increases the ability of the planning agency to coordinate with the agency which will implement the measures, leading to practical plans which are sensitive to local needs and problems.

The methodology followed by local plan making has been outlined in each of the case studies. Accounting for local differences, parking plans generally originate in either the local transportation or planning agency. These operating level agencies then recommend the parking-related measures to the legislative body, (the County or City Council or Board) for approval and funding. If rates are to be raised, as in Silver Spring,

TABLE 6

ALTERNATIVE FRAMEWORKS FOR REGIONAL PARKING MANAGEMENT PLANNING

	Process Management	Technical Guidelines (or minimum performance standards)	Uniform Measures
Grassroots Approach	No	No	No
Top-Down Directive Approach	Yes	Yes	Yes
Regional Guidelines Approach			
Procedural	Yes	No	No
Technical	Yes	Yes	No

or zoning ordinances to be changed, public hearings are required. In other cases, such as minor revisions in meter rates or locations and in enforcement policies, hearings are not held.

The normal comprehensive planning process is not usually applied to parking management, nor is a parking element usually included in local transportation plans. Although specific parking measures are continually being approved, no formal parking management plans have yet been developed in the Washington area. As a result, elected officials are often not involved in goal setting, internal coordination of operating agencies is not provided for and public input is often absent until final approval of a measure is being considered. Thus, the output from a totally local planning process is usually a series of ad hoc parking measures which may meet some local goals but does not address the broader needs of the jurisdiction.

Several specific weaknesses inherent in local planning became apparent from the case studies, even where adequate internal coordination of the planning process took place.

- Local planning generally fails to address the air quality aspects of parking management measures. The air quality agencies on the local level are not actively involved with either the comprehensive planning process or transportation planning. Although they have technical expertise in monitoring and enforcement, they do not have experience in transportation-related planning. One local exception is in Fairfax County, which is correlating air quality with urban growth and hopes to use environmental assessment procedures in land use decision-making in such areas as Centreville.
- Local planning cannot effectively maximize the regional potential of mass transit, particularly Metro rail.

Regional cooperation will be required to encourage ridership in order to decrease the total deficit and to reduce local deficit allocations. As illustrated by Rosslyn, local areas are often impacted by commuter auto traffic originating from neighboring jurisdictions, e.g., Fairfax County. Rosslyn would benefit from extensive fringe parking lots to divert auto trips, but has no means to develop them outside of its boundaries. Likewise, if the District acts to restrict parking, increased transit service must be provided by suburban jurisdictions if economic hardship is to be avoided for both the Core and suburbs.

- Local planning tends to avoid strong unilateral action for fear of placing the local economy at a disadvantage. This applies particularly to measures which call for increased rates or a reduction of spaces which might limit the attractiveness of older CBD's to shoppers. In spite of the fact that a freeze on spaces in the District, for example could result in a net financial savings for both businessmen and the city alike, the perceived fear is that supply reductions will result in congestion and economic hardship. One Los Angeles area county (San Bernandino) has predicated implementation of its parking plan on the adoption of similar plans by neighboring jurisdictions, and the same problem is envisioned for the D. C. region.

In summary, local planning only, while innovative and clearly applicable to valid local economic and social needs, is not capable of meeting the regional goals of air quality, mass transit support and energy savings. It usually does not recognize the costs of too great a dependence on the automobile in terms of congestion, noise, and land lost to parking and highways. Local initiative depends on the whim of politics and without regional encouragement, parking management planning is apt to remain uncoordinated, ineffective and in many cases, will not even be attempted.

2. Top-Down Directive Approach

This approach was used by EPA in directing preparation of the Transportation Control Plans by the states in 1973. For a variety of reasons it failed to accomplish what it sought: a workable set of measures which would reduce VMT and improve air quality to meet 1977 air quality standards. An examination of the Boston and Washington, D. C. experiences illustrates what happened.

Boston's initial TCP called for measures including prohibition of on-street parking, a freeze on parking construction without an EPA permit, a 25% reduction in employee parking spaces, and a parking surcharge. These were, in essence, dictated by EPA to the Boston region. Final amendments, however, modified and postponed all these measures after local opposition surfaced and their implementability was questioned.

In the D. C. area, the original TCP called for similar measures, although they were worked out by the National Capital Interstate Air Quality Planning Committee associated with COG and formally submitted by the States for EPA approval.

As shown in Table 6, this approach requires process management, regional guidelines and uniform measures, and essentially imposes them from the top down. Local government had a small role in preparing the TCP measures, since the staff of COG developed the plan in conjunction with the National Capital Interstate AQPC, which does not have local political representation. Approval was a function of the States. Local governments, therefore, felt intensely pressured and have, to some extent, resisted implementation of measures. Even the States, after publication of the TCP recommendations by the NCIAQPC, indicated that they felt that some measures were impractical and infeasible.

An analysis by COG[1] of the institutional problems surrounding the TCP planning process points out a number of specific weaknesses in this process as applied to the Washington area:

- Inability of the planning process to ensure the cooperation of the Federal government in its parking management measures. As the report indicates, "The desire of the Federal government to handle its responsibilities is a significant factor; however, the inability of the Federal government to do so is a significant institutional problem." [2] Although Federal workers had to bear the brunt of the proposed parking measures in D. C., there was no coherent parking policy on the Federal level nor any effort to coordinate Federal attitudes with the measures proposed.
- Lack of authority of the air quality control agencies over transportation related measures. In addition, no institutional mechanism existed for interface between the air and transportation organizations or for working out differences.
- The number of organizations involved in this interstate region make implementation, as well as planning, extremely difficult.
- Conflicts between the requirements for preparation of regional plans, as opposed to requirements that plans be adopted by the States, led to confusion of authority.
- Absence of a mechanism to plan and implement for the region, other than the NCIAQPC. This group, associated

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[1] "Review of Institutional Problems Associated With the Development and Submission of Implementation Plan Revisions in April 1973 for the National Capital Interstate Air Quality Control Region." Submitted to: Office of Technical Support and Special Projects, EPA, May 31, 1973. Metropolitan Washington Council of Governments.

[2] Ibid. p. 15.

with COG as its air quality planning arm, is composed of technical members from the two states and the District, plus three COG members. It lacks direct representation from the local political bodies which held final responsibility for implementing parking plans, and thus the approved plans were not responsive to local wishes or needs.

- A lack of adequate time and funding to develop and review plans.
- Confusion over deadlines and extensions available from EPA.
- Pressures to come up with an acceptable regional plan in a relatively short time under threat of EPA promulgation of a plan for the region.
- Expectation of massive reductions of VMT to be achieved by measures that were largely untried and difficult to implement.

Despite the intent of EPA to permit local involvement in the development of the SIPs and TCPs, this effort was not successful. The planning process would be improved if local government, rather than state level agencies could have been factored into the planning process. Perhaps, had the time frame allowed more leeway for planning and review, had technical knowhow in achieving clean air goals been further developed, and had a different structure been designed for the regional air planning body which involved local governments, the results would have been different.

3. The Regional Guidelines Approach

The necessity remains for a regional framework under which parking planning can successfully be undertaken. The third alternative strategy seeks to combine the strengths of local planning with a structure for addressing regional goals. This strategy envisions procedural and possibly technical guidelines, which are adopted on the regional level with the participation of local governmental representatives, accompanied by local preparation of parking plans consistent with the guidelines, as shown in Table 6. It does not call for uniform measures throughout the entire region.

The regional/local approach relies on a regional coordinating body such as COG or the metropolitan transportation planning organization to lead the regional parking management planning effort. It is recognized that, in the absence of federal sanctions or federal funding, such regional coordination will probably not be forthcoming. However, three factors could contribute to a growing consensus for regional action:

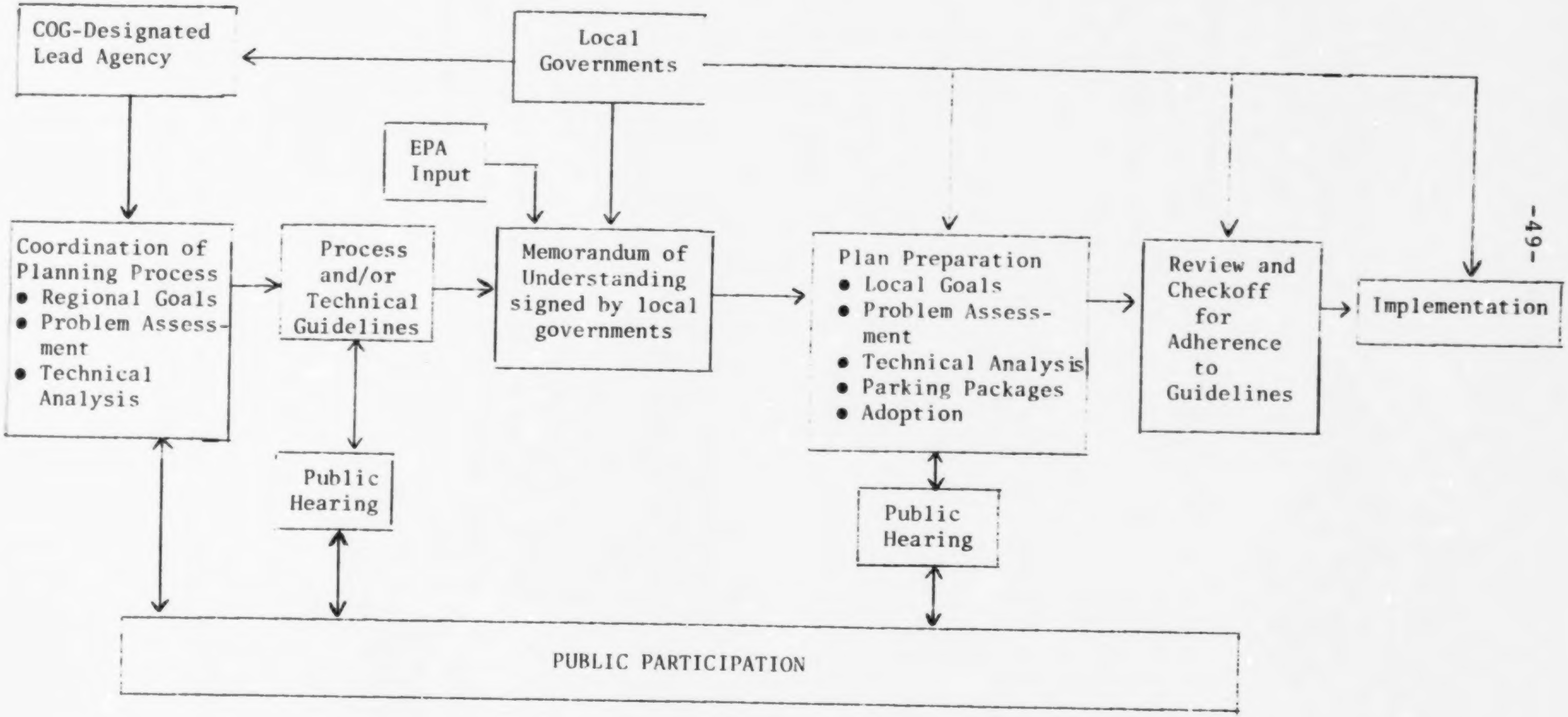
- The emerging interrelationships between parking and regional transportation planning especially the role of parking management in supporting mass transit.
- The general re-evaluation of the role of the automobile in light of energy considerations.
- Continuing urban air quality problems.

Once agreement is reached that parking management should be addressed on the regional level, whether under federal sanctions or voluntary cooperation, the regional body can begin to develop a regional planning process. The procedural steps that could be taken are outlined below and would result in a set of regional guidelines which would be approved by local governments and then followed in their local planning processes. This combined regional/local planning process is diagrammed in Figure 3.

- COG passes a resolution to undertake parking management planning as a regional effort.

FIGURE 3

REGIONAL PARKING MANAGEMENT PROCESS
LOCAL/REGIONAL APPROACH


COG-Designated Lead Agency
Local Governments
EPA Input
Coordination of Planning Process
• Regional Goals
• Problem Assessment
• Technical Analysis
Process and/or Technical Guidelines
Memorandum of Understanding signed by local governments
Plan Preparation
• Local Goals
• Problem Assessment
• Technical Analysis
• Parking Packages
• Adoption
Review and Checkoff for Adherence to Guidelines
Implementation
Public Hearing
Public Hearing
PUBLIC PARTICIPATION

- Determines source of funding
    - -- Federal grant - EPA, DOT, other
    - -- COG funds (from local contributions)
    - -- Specific local contribution for parking planning
- Designates lead agency to oversee planning process
    - -- Transportation Planning Board
    - -- Joint committee of TPB and AQPC
    - -- Ad Hoc Parking Committee including private parking interests and Federal government
- Defines goals of parking planning process
    - -- to develop process guidelines
    - -- to development of technical guidelines, i.e., minimum performance standards
- Requests formal support and participation from all member jurisdictions

- ● Lead agency prepares procedural and/or technical guidelines with participation of local governments.
    - Definition of problem
    - Definition of regional goals
    - Technical data and information gathering
    - Review procedure by local governments and COG Board during preparation of guidelines
    - Public input through citizens' committee and hearings
    - Hiring of parking advisor to provide technical advice as both regional guidelines and local plans are developed
- ● COG Board acts to approve regional guidelines (procedural or technical or both).
    - Public hearings required before resolution passed
    - Resolution calls for agreement of all local jurisdictions to guidelines and signing of a Memorandum of Understanding to that effect

- Memorandum of Understanding is signed by all jurisdictions indicating that they will adhere to the regional guidelines and prepare local parking management plans consistent with the guidelines.
    - State regulatory agencies (Air Quality agencies), EPA and/or DOT also sign memorandums and commit themselves to review and comment on local parking plans
    - Dates are established in Memorandum for submission of local plans to lead agency for review
- Local preparation of parking management plans.
    - Local governments designate own agency most capable of carrying out planning process
    - Citizen participation provided in local plan preparation as determined by locality
    - Approval by local government of the plan through its usual plan approval process
- Local plans submitted to COG lead agency for review and signoff for adherence to regional guidelines.
- Implementation of plans by local governments.
- Continuing review and evaluation by lead agency.

The key elements in this approach which distinguish it from past efforts are:

- Representation of local governments on the lead agency designated by COG to develop the regional guidelines. It is suggested that the Air Quality Planning Board, at least in its present form, not be the lead agency because it lacks direct ties to local government.
- Technical support from COG and a new"parking advisor" to aid in both regional guideline and local plan preparation.
- Commitment by local governments through a signed document to carry through a local planning process under the regionally-approved guidelines.

- Local preparation of specific plans including choice of measures best suited to each area.

Examples of the types of measures which might be drafted in the form of technical guidelines or minimum performance standards are noted below:

- Residential parmit parking system: Guidelines could include a model ordinance establishing a permit system which would avoid the legal pitfalls experienced by some jurisdictions. They could also specify criteria as to the type of area which should be considered for a permit system, e.g. percent of non-resident parking, expected impact from other parking measures, alternative transit availability and resident preferences.
- Zoning ordinances to reduce minimum spaces required in new buildings. Guidelines could be set in the form of model ordinances calling for flexibility in space requirements if a builder can show reduced demand; zero space requirements in certain types of neighborhoods; and maximum limits on the total spaces allowed. Criteria could also be set as to the type of situation where these measures would apply.
- Fringe parking provisions: Each jurisdiction could be required to provide a specified number of fringe parking spaces based on available transit service, number of workers it contributes to the Core, land availability, or auto ownership, similar to the Fair Share housing allocation formula. Parking at Metro rail stations could be similarly assigned.
- Absolute limitation on subsidies provided by local governments to employee parking, and a recommended reduction in the amount of private employee subsidized parking. The latter requirement is extremely hard to implement, but should be discussed at the regional level.

Although no exact parallels exist to this strategy as applied to parking management, there have been several cases where local governments have initiated regional cooperative efforts, without a direct Federal requirement, which are more binding than the usual COG-stimulated voluntary regional program. Examples of these in the Washington Metropolitan area are recent sewage treatment agreements and the Fair Share subsidized housing allocation formula:

- 1970 Sewage Treatment Memorandum of Understanding: Local governments committed themselves to regional cooperation and established general guidelines for cooperative efforts in a Memorandum of Understanding signed in 1970 regarding sewage treatment problems. This agreement was arrived at without any Federal directive, or even a Federal requirement that cooperation must take place. The document was signed by representatives from the District of Columbia, Fairfax County, Virginia and the Washington Suburban Sanitary Commission, acting for Montgomery and Prince Georges Counties, Maryland, after express approval by their respective governments. State and Federal regulatory agencies also signed, not as direct participants but to indicate their support and commitment to carry out their regulatory function. The Memorandum has become a legal document committing the signatories to certain financial contributions for regional treatment but more importantly, committing them to plan for future regional sewage capacity and to undertake interim measures to reduce pollution. The exact form of these interim measures was left to the jurisdictions, in the same way as local parking planning is left to the local government in the Local/Regional Approach.

- Fair Share Housing Allocation Formula: COG has recently been instrumental in working out an agreement by which local jurisdictions accept a specified amount of low and moderate income housing funded through HUD. COG's role was to agree in principle to the idea of an allocation formula based on indicators such as the amount of available residential land, number of low and moderate income units, over-crowded and deficient units, and other factors. The actual allocation formula was worked out through a special Affirmative Action Task Force composed of local government representatives under the auspices of COG. The allocation formula indicates to each jurisdiction what percentage of regional funds for subsidized housing it is entitled to receive. As a result of this cooperative effort, HUD has not only agreed to release the specified funds but given the region a bonus as well. However, the allocation formula was not a pre-condition for the release of funds.

In summary, the Regional Guideline Approach would assure that at a minimum, process management takes place at the regional level. Local governments help determine how the process will be carried out through participation in the lead agency designated by COG. A commitment is then required, through a signed Memorandum of Understanding, that local planning will adhere to the process management and time schedule established.

Stronger regional coordination would be achieved if the process went one step further: development of regional technical guidelines drawn up by the COG-designated agency and agreed to by the localities as the basis for their local planning effort. These technical guidelines could be generalized or in the form of minimum performance standards.

This process could be used in conjunction with future EPA or DOT regulations which require parking management planning in regional air quality and/or transportation planning. Several potential roles for EPA involvement were outlined in Chapter II for example specific parking measures for highly polluted cities; federal funding for parking management plans; EPA approval of parking planning regarding UMTA grants, or EPA review authority with regard to the annual transportation planning process, especially the consistency determination.

CHAPTER IV

PROCEDURES FOR PARKING MANAGEMENT PLANNING

A. Introduction

This section describes briefly the procedures for parking management planning. These recommendations are meant to supplement the introduction to this paper in which the general plan development process was discussed. Four areas are highlighted here:

- Technical preparation and analysis needed to select parking measures and evaluate their effectiveness;
- Means for analyzing the institutional framework of an area to elucidate possible constraints on community acceptance of developed plans;
- Techniques for evaluating the social and economic costs and benefits of parking controls; and
- The community planning process.

The discussions on each of these areas are not meant to be comprehensive; there are already numerous "how-to" manuals which aid those interested in using the proper tools to develop and evaluate plans for their areas. Rather, they are intended to describe the major steps which must be taken in parking management planning.

B. Technical Analysis of Plans

The technical phases of plan development evaluate the characteristics of auto traffic in an area. Supply of parking and demand for it must be measured, as well as availability and quality of alternate modes of transit. An understanding of the parking "system" in an area, will suggest the best parking measures for achieving whatever auto-related goals a community may have. There are three prime steps in this analysis, including collection of the necessary data, evaluation of the data to elucidate the important parking characteristics, and selection of applicable measures from which to develop a parking plan.

1. Data Needs

The data considered useful to developing parking management plans includes land use and activity level information, parking inventories and occupancy rates, and traffic and transportation system characteristics.

Different land uses contribute differently to vehicle generation. In addition, the concentration or level of activities will have an effect. For instance employment in the Washington target areas studied was derived by multiplying standard "per square foot" factors times floor space. Parking characteristics will also be impacted by land uses. Shoppers tend to turnover faster than workers, thus implying that more vehicle trips can be generated by any one parking space.

Growth in land uses must be determined in order to be able to predict future vehicle travel. As with measurements of present activity levels, data collection should stress the types and scale of expected land uses. It is noted that forecasted land use data is often inaccurate. In the case of Silver Spring, projected growth probably overstates what might reasonably be expected; in Rosslyn, planners hoped for slower growth than actually occurred. Thus, it will be important to continuously monitor actual development and compare it to forecasts. If divergences are great enough, parking plans may have to be revised.

Area traffic and transportation characteristics are vital to determine the modes used by persons leaving, coming to, or passing through, the study area. The variation in this data is normally quite large. The Origin/Destination Bus Study by WMATA was performed in 1972. Because of fare hikes, and service rerouting in the interim, it is not possible to get an accurate handle from this data on how many persons use buses to get to any particular location.

Parking data is also necessary. At a minimum this should include information on the number and type of spaces and their cost. However, the degree to which parking costs are subsidized, occupancy rates and location of spaces in relation to activity centers, are also important. Parking studies should not concentrate solely on spaces associated directly with demand activities (i.e., working or shopping). In addition, they should look at space provision at mass transit stations as well as at park and ride or fringe lots.

2. Data Analysis

Data analysis to evaluate the parking "system" of an area encompasses two steps. These include:

- Trip generation - The total number of present and future person trips generated by and through the study area must be determined. The technical means for performing this estimate range from the very simple (standard factors which can be multiplied by floor space areas) to the complex (models which weigh economic differences between areas, to establish the needs to journey amongst them). For regional studies, trip generation analysis also yields travel desire lines between a number of zones.

- Modal split - Once total trips are known, then it is necessary to calculate how they are divided among those using transit and those using automobiles. It is this exercise which allows person trips to be converted to vehicle trips. With this model, the costs associated with making trips by any mode, including running time, excess time, and dollar costs, are compared. Modal split models are generally supplemented by car occupancy models, which compare lower costs associated with carpools, against the convenience of single-occupancy driving.

Detailed analysis, such as is envisioned by the more comprehensive applications of these models will usually be beyond the financial capability of most areas considering parking management plans. It is generally found, though, that regional and sometimes state governments have been working in those areas. Thus, much of the needed information may have been generated already, or could be, by modifying the models now developed.

3. Analysis of Parking Measures

Two types of evaluation tools are needed in order to successfully measure the impacts of proposed parking control tactics:

- Sensitivity of parkers to parking cost. With this information it will be possible to judge how effective cost increases will be in diverting drivers to other forms of transit.
- Sensitivity of parkers to substituting supply constraints for price increases.

With knowledge of both sensitivities (they are derived from modal split models), then parking measures should be evaluated to determine the effect they will have on reducing travel. Such evaluations should culminate in the ranking of measures by how effective they are. Measures may then be selected according to the desired results.

C. Means for Analyzing Institutional Framework

Analysis of the institutional aspects of parking management requires an understanding of the governmental structure and the roles which various governmental and private agencies play in planning and implementation, both locally and regionally. Four specific types of information must be obtained and evaluated.

- Local Government Powers: The legal powers which are available to control parking on the local level should be studied, such as control of on-street parking, taxation and licensing, enforcement and residential permit systems. If additional legal authority is needed, this should be identified and the actions necessary to obtain it explained. The political as well as legal restraints to the implementation of parking measures should be noted. In addition, indirect powers to control supply of parking, such as through zoning, should be evaluated.

- Participants in the Planning and Implementation Process: The agencies which presently particpate in planning for parking management should be identified and their capabilities evaluated. For example, does the comprehensive planning department have any role in parking planning, or is it entirely planned and implemented through the local department of transportation? The appropriate lead agency for creating parking plans should be identified in each area and, if present policies need to be altered to enable this agency to function, suggested alternative institutional organizations developed.

- Process for Parking Management: The process by which parking plans are currently being developed must be understood and an evaluation made of the effectiveness of this process in meeting planning goals. Critical elements in the planning process should be identified, such as goal setting, problem assessment, technical analysis and plan selection, and any weaknesses which are found should be noted.

- Coordination within Local Government and Between Regional Jurisdictions: The mechanisms for coordinating planning within a jurisdiction should be clearly spelled out. Formal and informal mechanisms for coordinating planning and operating agencies should be noted and insufficiencies identified. The regional and sub-regional organizations which exist for inter-governmental coordination, their respective roles and responsibilities must be identified and the ones which could be most useful in coordinating parking management planning indicated. Where no regional mechanisms exist, suggestions can be made for institutions which could fill the gap, indicating who should be represented and why.

Information concerning these institutional relationships can be gathered by interview, by study of planning documents and organizational charts, and by case studies of examples of local, sub-regional and regional cooperation and agencies. There is no clearly defined process for conducting such evaluation other than to collect the required data, analyze it, identify problem areas and investigate alternatives.

D. Techniques for Evaluating Socio-Economic Impacts

The socio-economic impact analyses can be approached from several perspectives but can be done most effectively by first screening general problem types. Those problems which seem most important in an area can then be analyzed in depth. General categories include impacts on development, commuters (various income levels), local governments and residential communities. In depth analyses require understanding of the existing equilibrium which by definition exists prior to the imposition of parking management measures. Parking measures may upset the equilibrium causing stress to commuters, developers, etc. The degree to which these groups are affected can be quantified using some of the techniques described.

1. Development

In communities where attracting additional commercial or residential development is a goal, parking management effects will be felt primarily through zoning measures. The costs to developers of providing parking can be estimated. The developers' attitudes about whether zoning requires too much or too little parking will help predict the impact of a zoning law change.

If parking is profitable and there is a shortage, then a maximum zoning limit on parking could be useful. Even where parking is subsidized so that the demand is artificially kept high, a maximum ordinance could be effective. Examining historical growth trends, land prices and remaining zoned potential will clarify the economic attractiveness of the area. If it is attractive, strict parking management measures may not damage development significantly. Where excess supply exists, developers might even welcome reduced zoning.

2. Commuters

Parking measures are aimed principally at changing the mode of travel used by commuters for home-to-work trips. Consequently, commuters who choose to continue using autos may be heavily impacted. Rates can increase and supply decrease causing additional inconvenience.

Socially, concern would focus on the low income "captive" auto commuter. For example, commuters without a transit alternative for whom a parking price increase would substantially reduce take home pay deserve special consideration.

The impact on transit commuters may also be substantial. Commuters riding buses which exceed capacity could be forced to stand as load levels increased due to parking measures. Conversely, service could improve markedly if additional transit commuters justified the addition of new buses reducing headways.

These impacts can be quantified using available data on income by region, modal splits, excess transit system capacity, parking costs and demand elasticity. Use of this data is presented in the various case studies.

3. Local Governments and Residential Communities

Most transit systems operate at a deficit. Parking management which increases transit ridership will generally reduce the public deficit where excess capacity exists and increase it where substantial fixed costs must be incurred. For example, adding peak hour buses will increase the deficit but increased ridership during off-hours will lower deficits. To quantify the impacts requires data on fixed and variable bus/rail transit costs, existing capacity and load factors and existing deficits.

Local governments will also be sensitive to the political and social implications of parking management. Understanding the influence of developers, parking lot owner/operators, and local citizen groups on local officials will largely determine the acceptability of parking measures. If residential communities are concerned about commuter parking spillover, the acceptability of a residential parking ban, for example, will increase markedly.

The relationships discussed here are used in the case study analyses and are helpful in evaluating socio-economic impacts. The data collection and emphasis, however, must be tailored to the analysis for any particular region.

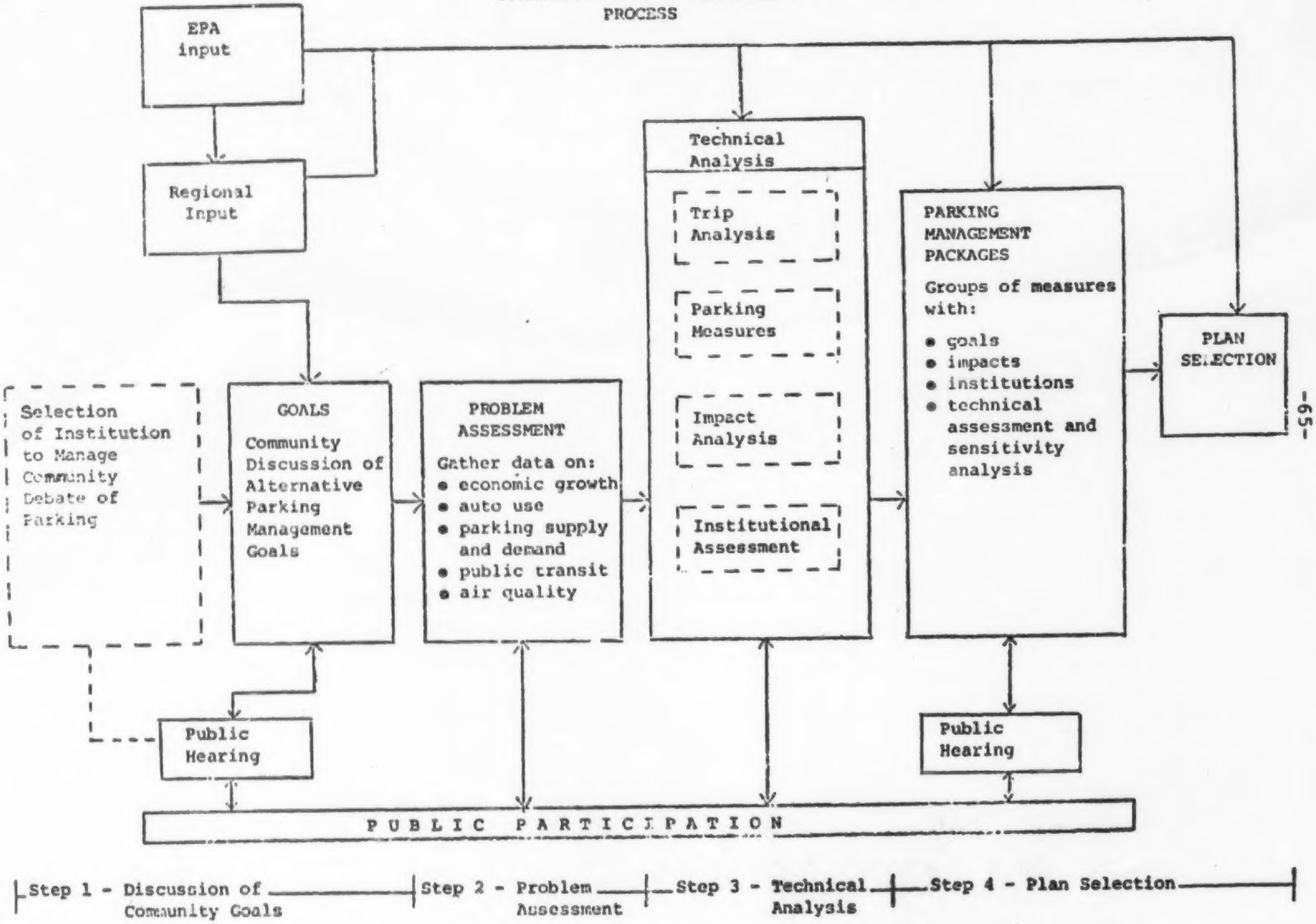
E. The Community Planning Process

The planning process for each community is diagrammed in Figure 4. The timing sequence generally proceeds from left-to-right in the diagram, although steps can be accomplished simultaneously. Various feedback loops may necessitate the accomplishment of several interactions of particular steps in the process.

The first step is for an institution to accept responsibility for leading the debate over the appropriate parking management goals for the community. A community is typically an urban concentration of between 25,000 and 150,000 people. The lead group might be an organization with general government or just planning responsibilities, or it could be a transportation, air quality or land use planning group acting on behalf of the general purpose government. This group should collect basic data on the role of the automobile in the community and consult with the regionwide COG-government and technical staff and with EPA. The emphasis at this point should not lie on precise data manipulation or technical exercises, but on the broad conceptualization of goals for managing automobile use in the urban environment. Among the goals that might be considered are:

Figure 4

COMMUNITY PARKING MANAGEMENT PROCESS


EPA input
Regional Input
Selection of Institution to Manage Community Debate of Parking
GOALS
Community Discussion of Alternative Parking Management Goals
PROBLEM ASSESSMENT
Gather data on:
● economic growth
● auto use
● parking supply and demand
● public transit
● air quality
Technical Analysis
Trip Analysis
Parking Measures
Impact Analysis
Institutional Assessment
PARKING MANAGEMENT PACKAGES
Groups of measures with:
● goals
● impacts
● institutions
● technical assessment and sensitivity analysis
PLAN SELECTION
Public Hearing
Public Hearing
PUBLIC PARTICIPATION
Step 1 - Discussion of Community Goals
Step 2 - Problem Assessment
Step 3 - Technical Analysis
Step 4 - Plan Selection

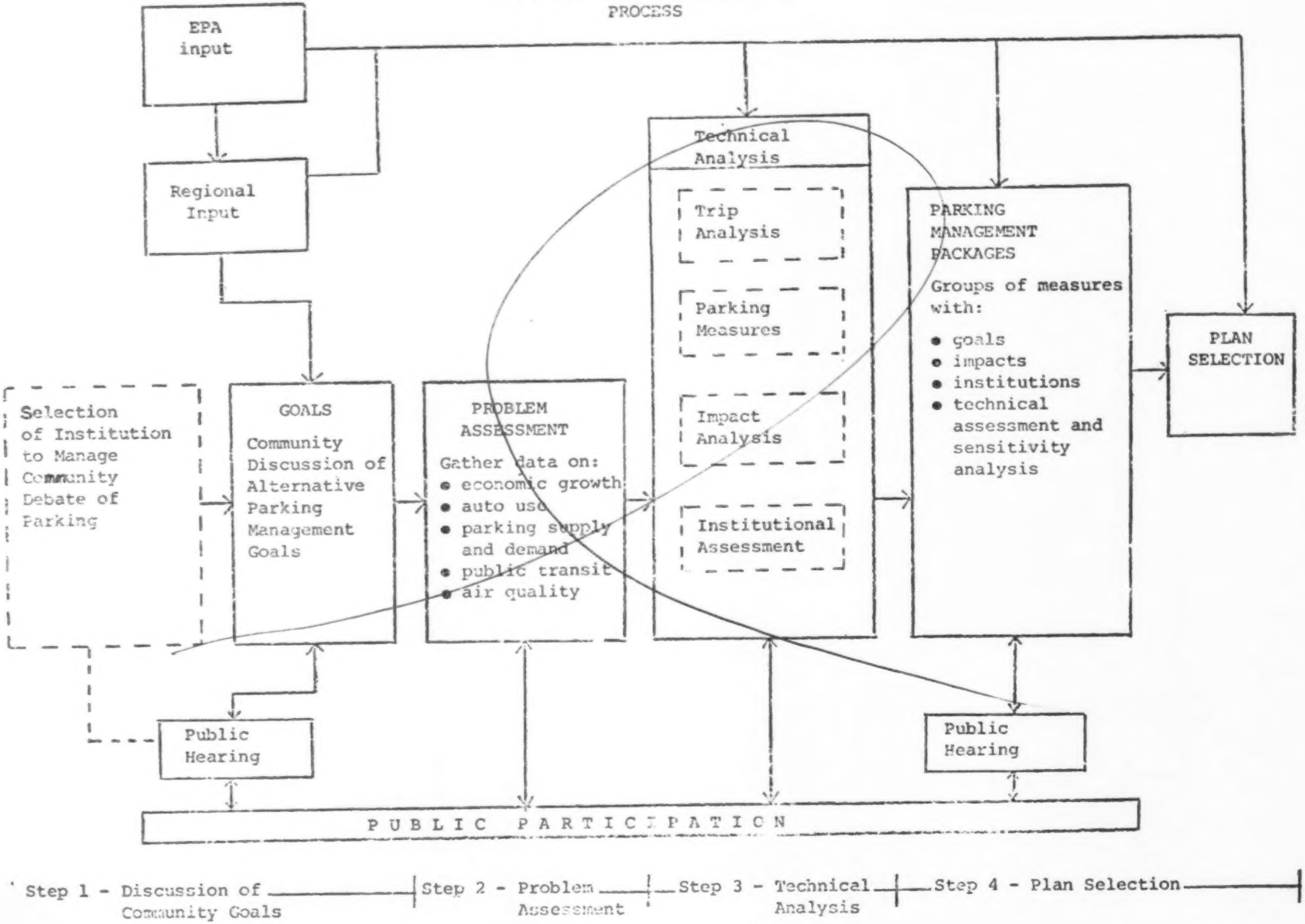
- giving priority treatment in terms of accessability of parking space to priority uses in an environment of limited parking supply. For example, residents should have spaces in front of their homes and space should be provided for shoppers necessary to sustain the commercial core;
- maximizing ridership on public transportation systems through the provision of disincentives to those auto uses most competitive with public transportation use;
- fully internalizing the cost of operating the automobile in the urban environment. This goal would emphasize the implementation of commercial parking rates in lieu of subsidized rates and, if possible, a premium parking charge to reflect the air quality, congestion and other external costs of supporting a large automobile population;
- reducing auto use to the maximum extent possible to attain air quality goals and energy savings;
- providing excess parking spaces so that all uses have adequate capacity regardless of the direct or indirect costs to the community.

These goals should be articulated in terms of the specific opportunities available to the community. Public hearings should obtain the views of:

- residents who cannot park at home;
- businessmen who need parking and reduced congestion to sustain their operations;
- regionwide and EPA spokespersons who can provide a regionwide viewpoint on problems such as air quality, highway and transit planning;
- public health spokespersons concerned about the impact of air pollution and noise on the community;

Figure 4

COMMUNITY PARKING MANAGEMENT
PROCESS


EPA
input
Regional
Input
Selection
of Institution
to Manage
Community
Debate of
Parking
GOALS
Community
Discussion of
Alternative
Parking
Management
Goals
PROBLEM
ASSESSMENT
Gather data on:
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• parking supply
and demand
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Technical
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Parking
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PACKAGES
Groups of measures
with:
• goals
• impacts
• institutions
• technical
assessment and
sensitivity
analysis
PLAN
SELECTION
Public
Hearing
Public
Hearing
PUBLIC PARTICIPATION
Step 1 - Discussion of
Community Goals
Step 2 - Problem
Assessment
Step 3 - Technical
Analysis
Step 4 - Plan Selection

- land use, police and other officials who cope with the automobile problems.

The hearings should focus on questions like the following:

- Does the community want to increase or reduce the automobile's role?
- Is there too little or too much parking?
- Where are the community's acute parking problems?
- What role should areawide priorities such as increasing public transit ridership and saving air quality and energy play in community decisions?
- How can the community sustain its businesses while at the same time bring pressure on excessive automobile use?

The second step in the process (see Figure 4) is to document basic facts about the community's parking situation. This is the problem assessment phase. Growth projections, land use patterns, public transportation ridership, air quality, parking supply and demand -- all of these should be examined. Simple and low cost data collection and projection approaches should be used.

Step three is the technical analysis. This step should always be subservient to the overriding task of goal setting. It should analyze trips taken in the community to determine the relative incentives to use the automobile or mass transportation. Parking management measures should be developed and applied to specific community problems. Impact studies should be conducted to determine the costs and effectiveness of various measures. Also, the institutions responsible for parking management planning and implementation should be examined. Their legislative authority, technical expertise, responsiveness to the public, and resources should be assessed.

In step four, various combinations of parking measures are combined into parking management packages consistent with:

- different views of the preferred parking management goals for the community;
- variances in key technical facts which are in doubt;
- possible actions at the regional level which may influence needed local actions.

The parking management packages devised should be presented to the public accompanied by:

- social, economic and environmental impact studies;
- explication of the required authorities and resources;
- a statement of consistency with Federal and regionwide requirements; and
- a sensitivity analysis to illustrate the technical weaknesses of the underlying facts and analysis.

Finally, a parking management plan should be adopted by the community reflecting both its local goals and the goals of the regionwide community.

CHAPTER V

PARKING MANAGEMENT PLANNING PROCESS APPLIED TO THE WASHINGTON, D.C. AREA

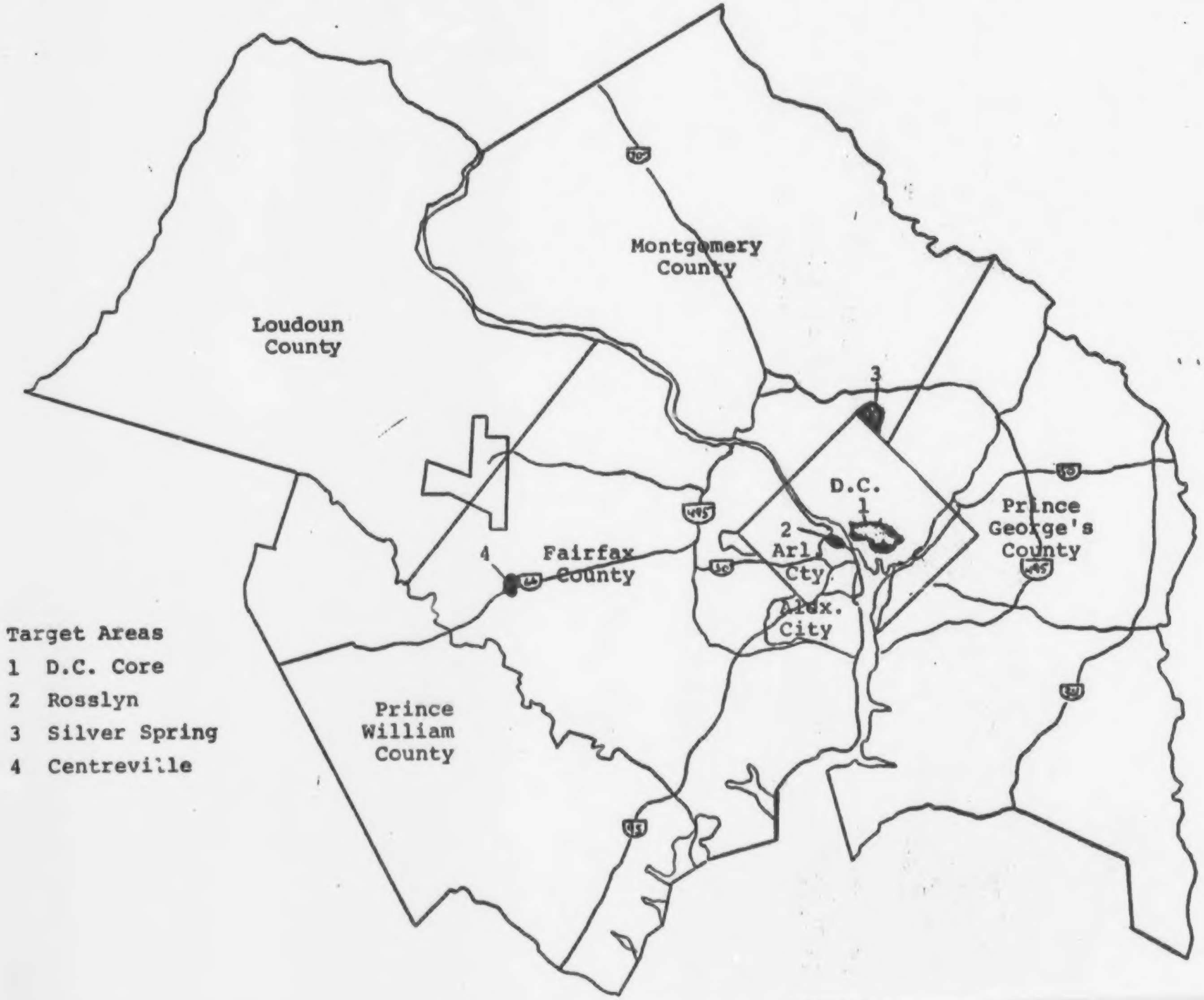
A. The Target Area Approach

The objective of this study is to develop a regional parking management planning process and to apply it in the Washington, D.C. area. Chapters V, VI and VII will describe how the planning process was applied to the D.C. area, specifically the selection of target areas, the evaluation of measures, and the development of a regional plan.

Within the resource constraints, the target area approach seemed to offer the best chance of testing the regional planning process. Four target areas were chosen and are shown on Figure 5 : The D.C. Core; Rosslyn, Virginia; Silver Spring, Maryland; and Centreville, Virginia. Separate appendices contain extensive descriptions of the four target area studies and summaries are found in Section C of this chapter.

The study of target areas simulates the portion of the regional planning process which would be carried out by local governments, e.g. determination of local goals and problems and analysis of specific appropriate parking measures. Under the "regional guidelines" planning process, this local effort would be carried out concurrently with regional actions. In this study, the information collected in the target area studies was developed into recommendations for a sample regional plan. While

FIGURE 5


Loudoun County
Montgomery County
Fairfax County
Prince William County
Prince George's County
D.C.
Arl. Cty.
Alex. City
1
2
3
4
70
495
66
50
95
301
Target Areas
1 D.C. Core
2 Rosslyn
3 Silver Spring
4 Centreville

the measures selected reflect feelings about those approaches to parking management which are technically most sound and institutionally most implementable, they are not proposed as the definitive answer to the myriad of parking related problems which afflict the Washington, D.C. region.

B. Methodology for Selecting Target Areas

The criteria used to select target areas are shown in Tables 7 and 8. Since the study concentrated on the home-to-work commute trip (seemingly the most divertable), target areas were chosen with varying types of employment concentrations and populations. The Washington COG divides the metropolitan area into a series of concentric rings which correspond roughly with population and employment density; a target area was selected from each of the four inner rings. In addition, a target area was selected from both states in addition to the District of Columbia, and from different county and city governments. Other factors considered in the selection of target areas included economic health, relationship to new Metro rail lines, and current state of development.

It is recognized that four target areas cannot describe all possible types of communities in a metropolitan region, but these were considered representative of types found in most urban areas. The D.C. Core was an obvious choice as the urban center and the largest single source of home-to-work trips. Rosslyn is a typical new, highly concentrated employment center just outside the Core. Silver Spring is similar to many older CBD's located outside the central city and beset with economic problems. Centreville is an undeveloped growth center where long-range parking management measures can be used to a maximum effect.

TABLE 7

CRITERIA FOR SELECTION OF TARGET AREAS

1. Location by urban ring
   - Central core (Ring 0 and D.C. portion of Ring 1)
   - Outer Core
   - Urban Ring
   - Outer Ring
2. Employment and Residential Densities
   - Highest (20-500 Jobs/acre - 13-100 units/acre)
   - High (5-20 jobs - 4-12 units/acre)
   - Lower (0-5 jobs - 1-4 units/acre)
   - Lowest (under 1 job and 1 unit per acre)
3. Land Use (predominant)
   - employment center predominately (Federal or Federal and private)
   - mix of employment, commercial and residential (also new or older CBD)
4. Transit accessibility
   - Future Metro rail
   - No future Metro rail
5. Institutional Framework
   - Location in Maryland, Virginia or D. C.
   - County or municipal government
   - COG member or Not COG member

TABLE 8

CHARACTERISTICS OF TARGET AREAS

D.C. Core

- Central Core location
- Highest employment and residential densities
- Mixed land uses
- Future Metro Rail
- District of Columbia government

Rosslyn

- Outer Core location
- High employment density
- Employment center only
- Future Metro rail
- Arlington County, Virginia government

Silver Spring

- Urban Ring location
- Lower employment and residential densities
- Mixed land uses - older CBD
- Future Metro rail
- Montgomery County, Maryland government

Centerville

- Outer Ring location
- Lowest employment and residential densities
- Mixed land uses - growth area
- No Metro rail
- Fairfax County, Virginia government

C. Summary of Target Area Studies

Four principal elements are of interest in these target area studies:

- local goals and their relationship to the regional goals;
- a description of the parking problems facing each of the communities;
- the parking plan and the measures chosen for that plan; and
- the institutional implementability of the parking plan.

An additional section explains the relationship between the Federal government and parking management efforts in the Washington region.

1. The D.C. Core

The D.C. Core was selected for analysis because 50 percent of the work trips made in the SMSA are to the Core. Over five percent of all regional trips are core-based home-to-work trips. The Core is also a shopping and tourist hub which complicates the role of parking management since these trips must be protected.

The most important function of the parking management plan in the Core is to boost transit ridership. Metro's focus is downtown, and if ridership cannot be encouraged there, then the economic viability of the entire system will be jeopardized. A secondary goal is the redevelopment of the center city to attract more tourists and shoppers. Comprehensive plans now under development call for additional shopping areas and hotels. Parking must support these activity centers and be protected from use by commuters. A parking policy must supplement the overall plan. For example, in the short-term, buses could take tourists downtown from fringe lots; long term redevelopment with tourist bus service to the major monuments from downtown hotels would eliminate the need for additional downtown parking.

Work trip modal splits to transit are projected to rise from 35 percent in 1974 to 55 percent by 1992, implying a 115 percent rise in transit use and a 4 percent decline in auto use. Should growth anticipated now occur, then auto use would be expected to be reduced even further. Non-commute auto trips (mid-day business and shoppers) are also expected to be reduced as a result of Metro.

However, such overall figures cannot be used except at the grossest scale to devise parking management plans in the target area. The analysis presented in the appendix breaks down the Core into six sectors in order to give a better understanding of distribution problems. Certain sectors (i.e. Southwest Mall) are expected to grow much faster than average and thus should expect, even with transit, pressure from more auto drivers. Other areas which remain constant in size will see a more substantial reduction in demand (Capitol Hill, for example, should have a reduction in vehicle trip generation of 20 percent.)

Demand for spaces currently is less than the total supply. In certain areas, though, modal splits to transit are much higher than average because there are insufficient spaces. Residential spillover occurs in some areas where adjacent parking is cheaper than that found in the Core itself. Total spillover is estimated at 4,000 cars.

Parking prices are the highest of any in the region. $2.55 is the average maximum daily rate. Monthly rates for off-street spaces average close to $40. Few workers pay these rates, though, as approximately 40 percent of them are currently subsidized by their employers. Thus, their commute mode decisions are not affected by the costs of parking.

An important factor in downtown parking is the Federal government. Twenty-five percent of Core spaces are government-owned or -operated. Approximately 50 percent of the workers are federally employed. The rates on government lots are much lower than the cost of providing them and range from $5 to $15 per month. Forty percent of them are free. Clearly, control of these spaces will be essential. A detailed discussion of Federal subsidies follows the target area summaries.

The parking plan suggested for the Core includes four strategies. First, a program must be initiated to get employers to voluntarily reduce or eliminate the subsidies they give. This can be done by raising employees' salaries commensurate with the subsidy in order to give them the choice of paying for the parking or diverting to some other mode. Second, in accordance with the wishes of citizens residing in adjacent neighborhoods, residential parking systems should be initiated. This will force spillover parking back into the Core. These drivers will have to pay the higher prices, carpool or divert to transit. To protect the spaces now used by shoppers and other non-workers, it will be necessary to reserve on-street spaces for these short-term parkers. Thus, a third strategy would be to eliminate long-term on-street parking with the express purpose of diverting those employees into garages. This will have the effect of forcing them to pay the full cost. However, it will also guarantee a supply of spaces which cannot be used by other than those for whom they are intended.

Lastly, long-term measures are aimed at satisfying the gains made in the short term by both Metro and the foregoing parking strategies. The primary vehicle would be a reduction of the minimum zoning requirement for office building parking supplies to zero. Additionally, an amendment would be made to the process of granting building permits to formally analyze the parking needs of each major proposed development. Such analysis would consider the vehicle generation characteristics of a building and the potential for diverting these trips to other modes of transit. Such a system would allow flexibility in providing spaces. If the number of Core employee spaces were frozen , D.C. developers would save more than $30,000,000 by 1990. To further encourage Metro ridership, a second long-term measure would analyze the potential for spaces at Metro stations on the fringes of D.C.

2. Silver Spring

The Silver Spring target area study focused on the needs of a community which was economically declining and wanted to revitalize its CBD. Silver Spring faces tremendous competition from shopping centers which have developed in the past decade around the preiphery of Washington. These centers offer free parking and shopping areas which are the equivalent of auto-free zones.

While Silver Spring has been intent on supplying enough parking cheaply to support the CBD, the parking problems which they now face are much more complex. The city has 21,300 parking spaces to meet the demands of commuters, shoppers and others. Yet, demand and supply are unevenly matched. Within the local area, some public lots are 100 percent occupied while others are only a fraction full. In high demand areas, parkers overflow into residential neighborhoods.

It was very difficult to consider future problems in the Silver Spring area because of the unreliability of the growth estimates. Characteristic of many areas, Silver Spring's growth projections were based more on hope than on historical growth trends. Planning documents serve the dual function of being advertising for potential investors and developers and also as a basis for the community's decisions on, for example, providing more services or accommodating future growth. The community hopes that the new Metro station will attract new high-rise residential and commercial development to help revitalize the CBD. A sensitivity analysis indicated that growth projections reflecting historical trends would completely alter the study's conclusions, predicting a future surplus of parking as opposed to a deficit.

A related parking problem concerns the new Metro station. WMATA had not allocated any parking to Silver Spring. Studies conclude that feeder buses, plus people within walking distance and those choosing to "kiss 'n ride," would be the sole users of the Silver Spring Metro station. As the time for opening the station nears, Silver Spring has had second thoughts about the accuracy of these projections. The city is vulnerable to an onslaught of Metro commuters because public parking is cheap and available. Either additional parking will have to be supplied or parking management measures will have to be instituted to protect public spaces supplied for the use of local commuters and shoppers.

The parking plan suggested for Silver Spring includes several short-term strategies. A residential permit system was suggested for the areas presently impacted by commuter and shopper overflow. Second, parking rates would be raised only for long-term parkers, not for shoppers. Increased parking fees for home-to-work commuters would divert auto drivers to transit. Differentiation between short- and long-term parkers could be made by putting in short-term meters, allowing very inexpensive parking for two hours and then raising the rates significantly for long-term parkers, or restricting supply by not opening lots until after most commuters would have arrived. It was suggested that parking be provided for the Metro station. One analysis indicated that the demand might approach 500 cars per day for persons to drive to Silver Spring and take Metro into the city.

There was little evidence, however, that this kind of plan would have been supported by the Silver Spring community. Silver Spring is currently most concerned with preserving and revitalizing the CBD and any actions that hamper this program would be viewed negatively by most of the parties involved.

The Silver Spring problem is extremely characteristic of CBD's located outside the core of a major city. In general, these CBD's must compete with newer shopping centers which were designed around the automobile providing cheap and easy access. Older CBD's tend to be located in more congested areas where parking supply is dispersed. A recent and growing trend towards turning these areas into auto-free zones has improved their attractiveness to shoppers. Silver Spring had given only casual consideration to converting two rather small areas into auto-free zones. While data is available to show that areas like Silver Spring must have parking to compete with shopping centers, adequate parking is no insurance that a CBD will be revitalized. In fact, the excess of parking in parts of Silver Spring indicates that the city may have overused parking as a tool for attracting new commercial development and shoppers. There is apparently a limit to the amount that can be accomplished with parking supply manipulation. Beyond this point, the inherent economic attractiveness of a CBD is what will determine its ultimate growth potential.

3. Rosslyn

Unlike Silver Spring, Rosslyn has had no problem attracting developers. Rosslyn is characterized by dense high-rise development which has filled most of the available space. Apparently, little thought had been given to using parking as a means of controlling growth in the area.

Most parking in Rosslyn is supplied by commercial developers as garage spaces in high-rise buildings. The current equilibrium in parking supply and demand is a result of a number of loosely related factors. Because the modal split to transit was lower than that predicted in the original growth plan, parking in the completed office buildings is not sufficient in most cases to meet worker demand. The slack has been taken up by lots which remain in undeveloped areas of Rosslyn and by the ready availability of residential parking. In addition, zoning requirements resulted in an overbuilding of hotel and motel spaces and these have been rented to commuters. Yet, demand for parking in Rosslyn is high despite the fact that they have one of the lowest ratios of employees to parking spaces. This reflects both the auto intensive nature of the businesses in Rosslyn (e.g. consultants and salesmen) and the subsidization of spaces by employers and by rents.

The study found that parking fees in Rosslyn did not cover the costs of constructing and maintaining parking spaces. Parking was used as a means of attracting tenants to buildings and parking costs were subsidized by building rents. Employers also tended to subsidize their employees, so very little of the actual cost of parking was paid by the auto commuter.

Two parking management approaches are possible in the Rosslyn area. A stringent plan would involve implementation of a residential parking ban in the area, a ban on future construction of parking spaces and a request for voluntary elimination of employer subsidies. A more gradual approach would involve the decrease or elimination of minimum zoning requirements. This measure, coupled with the residential parking ban imposed in neighborhoods where it was requested, would gradually decrease the supply of spaces relative to demand. As completion of development in Rosslyn occurred, the number of employees per space would increase along with the price of parking. These measures would be coupled with a voluntary employer subsidy elimination and encouragement of carpooling.

Institutionally, the powers to implement this plan are held by the County Board, although a challenge to their right to institute a residential parking ban has been upheld in the courts. The Northern Virginia Transportation Commission has also been very active in advocating that parking rates be increased and supply decreased to divert more riders to transit. The County may choose to force new developments in Rosslyn not to provide parking. The major question then becomes: Will developers construct high-rise buildings without associated parking?

Of all of the areas investigated, Rosslyn seemed to have the best chances for successfully restricting parking in this manner. The County is already critical of the extensive development that has taken place in the area and has not expressed much concern about the possible loss of future tax revenue. In fact, a citizen's committee studying the Rosslyn-Ballston Corridor suggested thay some of the remaining land be devoted to parks as opposed to more high-rise construction.

4. Centreville

Centreville is representative of those areas lying outside the CBD which have yet to become fully urbanized. In these areas, the potential exists to avoid the kind of remedial parking measures recommended for other areas. The community is still in a sufficiently formative stage where the types of congestion and air quality problems characteristic of more urbanized areas have not yet developed. Fairfax County develops Centreville plans and has been very innovative in land use controls and cognizant of the role of the automobile in new development. The County's goals include decreased dependence on the automobile and increased use of transit. High density townhouse type developments have been constructed and provide an ideal point from which home-to-work commute trips to the Core can be conducted by transit. Planned development centers may take this concept one step further by mixing land uses in a concentrated area. In these cases, the need for commute vehicles can be considerably reduced since home-work centers are in proximity.

Presently, Centreville has no parking problem. The goal of parking management in a marginally developed area must be either to anticipate future problems or to support other areas of the region which currently have parking and congestion problems. Anticipated development for Centreville would approximately triple the population in the next 10 years but there would still be less than 27,000 people. Some planners indicated that the kind of congestion characteristic of Rosslyn or Silver Spring probably would not appear in Centreville for the next century. However, almost one-half of the Centreville residents travel to the D.C. Core, Alexandria and Arlington. These residents contribute substantially to traffic congestion and air quality problems in other parts of the region. Bus ridership in the area consists of less than 70 passengers per day going to the Core. No projections were available for future transit growth and the probability of Metro rail coming to Centreville is considered relatively low.

Employment growth in Centreville is expected to be rather marginal. Only 8 to 13 percent of the work force living in Centreville will ever work there. However, Fairfax County predicts that most employees living in Centreville will work in western Fairfax County in the Dulles, Manassas or Fairfax City areas. Data is unavailable to support these projections but planners are counting on these home-work patterns to cut the need for additional capacity on commuting routes to the Core.

Two types of strategies were considered in the plan for Centreville. The first involved fringe parking for bus transit. The Centreville plan now contains a recommendation for a very large lot for fringe parking located near the center of the city. Presumably buses would be provided to the Core and western Fairfax County for persons parking in this lot. The success of this measure, however, would be largely dependent on the form which growth takes in Centreville. In Reston, for example, fringe lots are unnecessary because the density of development allows buses to stop at several pick-up-points within the city before beginning their express haul to the Core. If development in Centreville turns out to be more sprawl than high density, the need for fringe parking would be great. This is a case where local zoning decisions must be closely tied with parking policy.

The second strategy concerns zoning and planning. Minimum zoning requirements in the area provide sufficient spaces for the people currently residing there. Minimum parking requirements could be relaxed to encourage transit usage and minimize reliance on the automobile. Developers would still retain the right to provide more parking but they could save money in areas where minimum parking requirements are excessive. The reduction in zoning requirements could stimulate more innovative approaches to transporting shoppers and residents. For example, minibus service might be provided in lieu of parking. In addition, the land use plans which Fairfax County has been generating could enhance mixed land use development. This would also reduce dependence on the automobile and the need for further parking restraints.

D. Parking Provided by the Federal Government

This section discusses the relationship between the Federal government, as the region's single most important employer and parking management.

1. Background

The Federal government's stance on employee parking was discussed in a memorandum accompanying an Office of Management and Budget Draft Circular, (April 1972). Although never officially adopted, the memo is the only existing statement of Federal policy. Issued by GSA during the energy crisis in 1974, it says in part:

> "The proposed policy would assure that agency requirements and operating effectiveness are not hindered by the lack of adequate employee parking facilities while also assuring that the provision of such parking facilities would not serve to augment employee compensation at Government expense. Further, in view of the environmental problems caused by the operation of automobiles, especially in urban areas, and in view of the government's support for public transportation projects, the policy would permit the acquisition or construction of the minimum parking facilities commensurate with the effective operation of government agencies".

The memo represents a very recent attempt on the part of the government to use parking as a means of encouraging some of its program goals. Historically, the government has used parking as a means of attracting employees. Lagging behind private industry in the salaries it could offer, the government provided parking as an employee benefit. However, while salaries are now more equitable, the parking policy still reflects employee subsidies. Moreover, provision of free or low-cost parking as an employee benefit poses conflicts with other expressed government goals:

- to support transit
- to comply with EPA air quality standards
- to lessen energy consumption.

2. Administration

Parking for Federal employees is administered principally by GSA and the Architect of the Capitol. In 1974 GSA published a temporary regulation (above); it established criteria for parking space assignment as follows:

> "At least 90 percent of employee spaces would be assigned to carpools according to the number of persons in the carpool. Employee spaces are those available after government vehicles, other official parking and visitor vehicles are accommodated".

While actual numbers of carpool assignments and occupancy are not available, an informal inquiry conducted by the National Capital Planning Commission confirmed that several large agencies do comply with the regulation giving high priority to carpools.

By far, the most successful carpooling venture is the Pentagon's. The energy crisis in combination with preferential parking for carpools spurred carpool growth from 300 in December 1973 to 5,000 in March 1974, with an average occupancy of 2.6 persons.

As a result, there are enough unused parking spaces in the north lot to allow 1200 spaces to be allocated for Bicentennial visitors.

The effectiveness of other Federal agency carpooling programs has not been documented. Originally, most operated on a point system so that spaces were provided to employees or employee carpools with the highest number of points until all spaces were filled. These programs encouraged carpooling but did not result in empty spaces as the Pentagon program did.

N.C.P.C. officials feel parking restraints could not only interfere with carpooling, but could divert carpoolers to transit at peak hours, when it is least able to accommodate them.

All employee parking at the Capitol falls under the purview of the Capitol Architect. There is not at this time any indication that the assignment of spaces follows criteria similar to that of GSA; also Capitol parking is free.

3. Pricing

Pricing policy for GSA managed parking is to charge only at contracted parking facilities, and only enough to recoup the operating cost charged by the contractor. All other parking is free, with no attempt to recover any of the capital costs which are considerable.

The average fee that is charged at a contract facility is $9 per month; the maximum monthly charge is $20.00. These figures fall below the average and maximum rates used in private facilities. ($32.00 per month average and $55.00 per month maximum.)

In contrast to the Federal parking subsidy, a D.C. government employee must pay market rates ($20-$30.00 per month), as a matter of government policy. These fees were imposed by the D.C. government concurrent with air quality plans proposed in 1973. Arlington County government has plans to remove employee parking subsidies and increase employee salaries by an equal amount thereby leaving the choice of transportation mode entirely up to the employee.

4. Federal Parking Supply

Table 9 presents the distribution of Federal employment and parking. The Federal government controls almost 39,000 parking spaces, 25,500 of which are provided free.

In Ring O at the present time, there are over 76,000 Federal employees. Of these, 72 percent occupy government owned buildings, while 38 percent work in government leased space. The total Federal parking supply in Ring O is estimated at 11,078 spaces. The ratio of total Federal employment Ring O to the total Federal parking supply is 6.88:1. However, the ratio does not represent the actual Federal employee/parking supply relationship, because total Federal parking supply is underestimated for the 38 percent of the employees working in leased space. The ratio of employees in owned space to total parking which is 4.28:1 in Ring O is a closer approximation of parking availability. However, this ratio is too low because it includes those leased spaces counted as part of the Federal parking supply.

Over 68,000 Federal employees work in the D.C. portion of Ring 1; of these, only 6,100 work in leased office space. Total Federal parking supply is 17,075 in owned facilities; therefore, the total number of employees per Federal owned space is 4.00, compared with a 6.88 ratio in Ring O. However, since the amount of employment in leased space is so small, the actual demand-supply relationship is probably better approximated by the ratio of employment in Federal owned space to parking in Federal owned buildings: 3.64 to 1.

TABLE 9

FEDERAL EMPLOYMENT AND PARKING SUPPLY

Ring 0, Ring 1

Sector	Total Federal Employment	% Emp. in Owned Office Space	Parking		Ratio of Employees in owned space to total parking
DC Ring 0			Total Fed.	Free	
001 NW Rectangle	21,436	83	3,809	1,627	4.65
002 Conn. Ave.	9,463	0	297	217	-
003 McPherson Sq.	19,131	36	987	300	4.31
004 Mt. Vernon Sq.	6,647	66	1,665	687	2.65
005 Municipal Ctr. Fed. Triangle	16,016	72	2,502	1,825	4.59
006 White House	10,673	89	1,818	763	5.24
Sub Total	76,166	62	11,078	4,732	4.28
Prescribed ratio					6.00
DC Ring 1					
101 Foggy Bottom-Georgetown	2,462	41	863	863	1.17
102 N.Dupont Circle	111	0	110	0	-
103 West Shaw	19	-	19	-	-
104 East Shaw	-	-	0	-	-
105 Union Station Area	3,961	22	2,896	945	0.59
106 Capitol Hill	19,580	100	5,193	5,193	3.77
107 Southwest Mall	41,042	96	7,803	2,767	5.06
108 W.Potomac Park	1,192	100	210	210	5.68
Sub Total	68,367	91	17,075	9,978	3.64
Prescribed ratio					4.00
DC Total	144,533	76	28,153	14,710	3.89
VA Ring 1					
131 Pentagon	28,287	100	9,661	9,661	2.62
132 Navy Annex	5,566	100	1,068	1,068	5.21
133 Rosslyn	6,636	0	70	70	-
Sub Total	40,489	84	10,799	10,799	3.15
Prescribed ratio					3.00
Overall Total	182,021	77	38,952	25,509	3.61

(Source: National Capitol Planning Commission, with General Services Administration Public Buildings Service, (Quarterly Report on Assignment and Utilization of GSA Controlled Space in the National Capital Region as of June 30, 1975, and Washington Metropolitan Council of Governments)

5. Congressional Parking Supply

Table 10 presents data for sectors with more than 70 percent of Federal employees in owned office space; it is the most accurate representation of the employee:parking space relationship, since it is possible to identify the precise amount of parking in office facilities which are owned by the Federal government. The data is presented in order of increasing employee:parking space ratios.

The distribution of spaces, both free and low cost, varies significantly from sector to sector. In the D.C. portion of Ring 1, employment sector 105 (Capitol Hill) stands out in having a very low employee to space ratio (2.62). In the D.C. portion of Ring 1, sector 107 is next closest with only about half as many spaces per employee. What is perhaps most astounding is that all of the Capitol Hill spaces are free. A visitor to Congress quickly learns that few spaces are available for non-Federal employees. The Pentagon which is the only sector with a lower ratio has such an effective carpooling program that it has 1200 spaces not in use.

6. Price Increases and Impacts

The preceding sections demonstrate the prevalence of parking subsidies for Federal employees. While the Federal government is not the only employer to provide parking subsidies, the policy is especially curious because it conflicts with other Federal goals. To continue to subsidize employee parking is:

- inconsistent with Regional Air Quality goals and Federal standards
- not cost effective
- inequitable because the poorest government employees who may not drive receive no comparable subsidies

RATIO OF FEDERAL EMPLOYEES TO FEDERAL PARKING IN SECTORS WITH HIGH PERCENTAGE OWNED SPACE

Percentage Total Federal Employment in Owned Office Space	Sector Federal Agencies	Number of Parking Spaces	Number of Free Spaces	Ratio Federal Emp. in Owned Office Space-Fed. Controlled Parking Supply
100	131 Pentagon	9661	9661	2.62
100	106 House Office Bldgs., LDC,Capitol,Supreme Court, Botanical Gardens	5193	5193	3.77
72	005 IRS, Justice Dept., Archives, FTC, FBI, US District Court Court of Military Appeals	2502	1825	4.59
83	001 DOI, GSA, USIA, State Dept., Fed. Reserve Bldg., Bureau Indian Affairs NAS	3809	1627	4.65
96	107 Smithsonian Museum, NASA,FAA, Agriculture, Bureau of Engraving and Printing GSA-R3, HUD, DOT, HEW, FBI	7803	2767	5.06
100	132 Navy Annex	1068	1068	5.21
89	006 Executive Offices, White House,Treasury Dept.,Commerce,P.O., ICC,Coast Guard,Labor	1818	763	5.24
100	108 West Potomac Park	210	210	5.68

- no longer defensible as an employee benefit.

The Federal government has been criticized for doling out funds for Metrobus operating subsidies, while the government continues to provide free/low cost parking for its commuting employees. For example, the annual tab for employee parking at the Pentagon is $4.5M while only $1.5M is appropriated as a bus operating subsidy for Northern Virginia (FY 1975).

Raising free and low cost government parking spaces to market rates could provide approximately $14M per year in additional revenue.1/ Assuming that some spaces would be exempt from this price hike, the additional revenue would be reduced.

According to GSA officials, however, prices increases would require a change in their charter because they are forbidden to earn a profit. In addition, there are no legal or institutional channels to make parking revenues available for mass transit. Both Congress and the Executive branch would have to act in order to change Federal parking policies.

The major negative impact of a price increase would be on Federal employees. In a letter to EPA officials, the Chairman of the Civil Service Commission strongly objected to a price hike, stating it would lead to grave labor management disputes. He further asserted that the policy was not wisely designed to meet the "legitimate goal of reducing air pollution." An additional objection mentioned earlier to across-the-board increases is the possibility of pricing some carpoolers

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1/ Assumes raising the price of government spaces to $40/mo. in D.C. and $30/mo. in the Virginia portion of Ring 1.

out of the market, and diverting more people to transit during peak hours when the bus system is already overloaded. Consequently, increased parking prices would have to be coordinated with the beginning of Metro rail service.

CHAPTER VI

EVALUATION OF MEASURES FOR THE REGIONAL PLAN

A. Introduction

This chapter describes how information gathered in the target area studies was used to develop the regional plan, what measures were evaluated and the criteria used to evaluate them. In practice, representatives from local governments and the regional coordinating committee would work together to determine what parking elements could be implemented in the region. The process of combining and trading off elements from the local plans to produce a coordinated regional plan was simulated in the study.

B. Evaluation of Data from the Target Area Studies

1. Target Area Characteristics

Table 11 provides some vital statistics on each of the target areas. The D.C. center is typical of core areas. It is the largest employment center, providing jobs for one out of every three workers, and drawing commuters from all parts of the region.

Rosslyn is primarily an employment center and the only area where daytime employment exceeds resident population. Silver Spring is a mixed use area with substantial employment, residential and commercial areas. Centreville contains very little employment and almost all residents commute to other parts of the region.

TABLE 11

GENERAL INFORMATION ON TARGET AREAS

	Ring Location (see map)	Population	No. Of Workers Living In The Area	Employment In The Area	Percent Of Workers Living In The Target Areas And Working In The:	
					DC CORE	DC
DC	0	756,492	335,344	492,266	14%	66%
Silver Spring	4	77,502	36,295	17,947	12%	40%
Rosslyn	1	12,157	8,126	19,833	19%	52%
Centreville	7	8,835	5,288	very small	7%	20% *

*rises to 45% if Alexandria and Arlington are included.

Source: 1970 Census

TPB - Commute Trip Studies

Growth rates in each of these areas also differ. The D.C. Core has shown steady growth over the past decade while Rosslyn has grown exponentially. Centreville is a future growth area with its population expected to triple over the next decade. Silver Spring represents areas that are stable or declining.

In summary, the target areas represents tremendous variety in terms of economic attractiveness, stage of development and type of development. They also represent different jurisdictions and illustrate the types of local considerations which must be taken into account in the development of a regional plan.

2. Local and Regional Goals

Table 12 summarizes the parking management related goals in the target areas and compares them to regionwide goals. These goals are of three types: economic, environmental and social. All the target areas compete for economic growth. Increasing Metro ridership to decrease deficits was also a commonly held goal. Environmental goals, such as air quality improvement or traffic congestion reduction, are heavily emphasized at the regional level but much less so within local jurisdictions. Most communities shared the goal of protecting existing neighborhoods from spillover. Parking also supported unique local goals, for example, attracting tourists to D.C., assisting the Silver Spring Parking District, or attracting shoppers to Centreville.

3. The Parking Problem

Table 13 illustrates the parking supply and demand situation currently and in 1980 for all of the target areas except Centreville. Centreville was excluded because it is currently not an

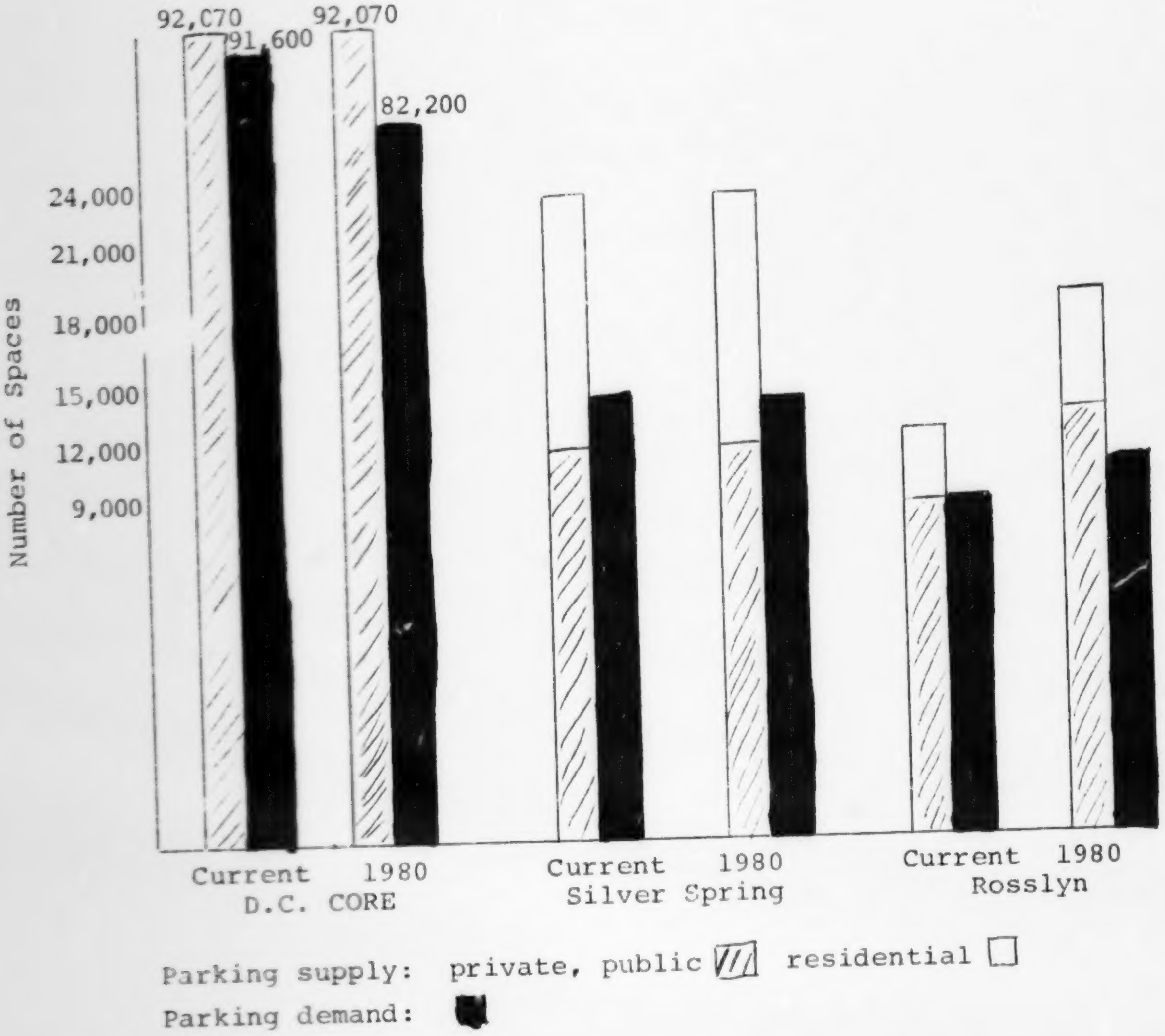
TABLE 12

TARGET AREA AND REGIONAL GOALS

Goals	District	Silver Spring	Rosslyn	Centreville	REGION
Economic					
Attract more business	X	X	X	X	
Attract more shoppers to CBD	X	X		X	
Increase Metro ridership	X	X	X	X	X
Make parking district self-supporting		X			
Increase residential development	X	X		X	
Environmental/ Social					
Improve air quality	X	X	X		X
Reduce traffic congestion	X	X	X		X
Protect existing neighborhoods	X	X	X		

TABLE 13

UNCONSTRAINED PARKING SUPPLY AND DEMAND



employment center and parking supply for home-to-work commuters has little meaning. In the target areas, parking supply always exceeds demand although in some cases it requires spillover into residential spaces. However, since these estimates cover large areas, local shortages and surpluses are not shown. By 1980, surpluses will probably increase as the number of area workers diverted to transit by Metro rail exceeds the growth in auto commuters.

The estimates in Table 13 do not include implementation of parking demand measures. They assume the existence of Metro but do not account for any additional parking restraints. Some rate adjustemnts and supply changes can be expected when Metro rail opens.

4. Transit Availability

Table 14 shows the present modal split to transit in each of the target areas. With the exception of Centreville, all of the areas will have access to Metro rail. All target areas offer relatively good transit service to the Core while service to CBD's outside the Core is fair to poor. Transit service will improve once Metro rail becomes operative. Buses formerly used for line haul service to the Core can then be diverted to feeder bus and local service. With the introduction of Metro rail, WMATA predicts that the modal split to transit in D.C. will increase from 35 percent to 55 percent, in Silver Spring from 11 to 20 percent, and in Rosslyn from 20 to 35 percent. These increased modal splits reflect the impact of Metro rail.

TABLE 14

TRANSIT AVAILABILITY IN TARGET AREAS

	D.C. Core	Silver Spring	Rosslyn	Centreville
The site of a Metro stop in:	1975	1976	1976	none planned
Metroline to extend beyond this stop	yes	after 1981	after 1978	none planned
Bus access --				
to the D.C. Core	--	good	very good	fair
to its CBD	good	fair	fair	poor
Present Split to Target Area				
Auto Driver	43%	66%	62%	almost 100% auto related
Auto Passenger	22%	13%	12%	
Transit	35%	11%	20%	
Walk	--	5%	6%	
Other	--	4%	--	

C. Parking Measures Considered for the Regional Plan

1. Types of Measures

Given the scope of this effort, it was only feasible to investigate the aggregate parking supply-demand relationships and the measures which could be used to influence these. More detailed analysis would be done by local governments as they develop specific parking management plans.

Three basic categories of parking measures were considered for the D.C. region in terms of their impact: parking supply, parking demand, and support measures. Table 15 lists each measure by category.

Parking supply measures increase or decrease the amount of parking and change the geographical distribution of spaces. In addition, this category includes strategies which change the type of parking, for example, replacing on-street spaces with the same number of spaces in lots or garages.

Parking demand measures impact the price of parking. Parking prices may be lowered as an incentive for certain trip types such as shopping or raised as an incentive for commuters to use transit rather than automobiles. Not all parking demand measures have a direct impact on the price of parking. For example, elimination of free parking would force parkers into commercial spaces which would involve additional cost.

Support measures are generally low cost actions which do not make dramatic changes in the parking system. These activities support parking supply and demand measures, enhancing the attractiveness of other modes of travel such as bicycles and carpools.

TABLE 15

PARKING MEASURES

Parking Supply Measures

Provision of Park 'n Ride Lots in Fringe Areas
Provision of Parking at Metro Stations
Limitation of Parking Supply Through Zoning Changes
Elimination of On-Street Commuter Parking
Residential Permit System
Parking Facility Review
Auto-Free Zones

Parking Demand Measures

Increase in Current Parking Rates
Institution of a Parking Surcharge
Elimination of Subsidies to Commuter Parking
  -- by employers
  -- by rate structure

Support Measures*

Provision of Preferential Carpool Parking
Enforcement of Parking Measures and Violations
Provision of Secure Bicycle Parking
Public Information Campaigns

* The proposed Metro system was assumed to be fully in operation as a support measure by 1990.

2. Description of Measures Evaluated for the D.C. Region

The measures analyzed for the D.C. region are described in terms of their applicability, their impact on auto-driver trips and their feasibility given present institutional considerations.

a. Parking Supply Measures

Park 'n Ride Lots in Fringe Areas: Park 'n Ride lots for bus passengers located at future Metro rail station sites or on non-rail corridors would be served by express buses connecting to the CBD or rail station. Park 'n Ride lots are often developed as a free service to promote bus ridership and therefore the transit trip should have the distinct cost as well as convenience advantages over parking in the Core.

Parking at Metro Stations: Parking is expected to be provided at most Metro stations outside of the District of Columbia. The difficulties lie in determining how much parking is adequate and meeting the goal of maximum Metro ridership without increasing congestion or VMT. Ideally, parking at Metro stations should not act as an incentive to drive to the station rather than ride the feeder bus. This, however, requires adequate bus service. It is unlikely that any practicable feeder bus service will totally eliminate Metro stimulated parking demand. It is possible that a much higher demand will exist for parking at outer Metro stations than is presently planned, and increased parking supply in these areas should be investigated as a way of diverting auto drivers to transit. Local political considerations, for example, citizen opposition to parking lot locations, may present difficulties in optimizing parking supply at Metro stations.

Limitation on New Parking Spaces: This measure refers to policies which plan and coordinate parking supply increases. Parking provided by private developers can be limited by revisions in the zoning requirements, special exceptions, or a temporary freeze in parking supply. This measure would constrict supply commensurate with growth and force the use of transit or carpooling.

Elimination of On-Street Parking: This measure removes on-street parking in the Central Business District from use by long term parkers. This can be accomplished through metering or by establishing time limitations (e.g. no parking until after 10 a.m.) which do not conform to commuter needs.

Residential Permit System: Residential parking controls are used primarily where commuter parkers overflow into surrounding residential streets. It allows residents with stickers to park near their homes but bans all cars without stickers. It prevents spillover which may result from other parking control measures. A residential parking ban would have the effect of diverting affected drivers to commercial parking or transit or to carpools using commercial lots.

Parking Facility Review: An alternative to freezing the parking supply through zoning changes would be modifying the building design review process to include an analysis of parking needs. Local authorities would estimate the potential parking demand exerted by a building to insure that extra spaces were not provided for those who could take transit or carpool. Developers already should be estimating their space needs, so this measure merely formalizes the process.

Auto Free Zones: Auto free zones are clearly within the powers of local governments and are currently planned for several areas in the District of Columbia. Roads crossing these pedestrian malls will carry only midi-buses, emergency vehicles and bicycles.

These zones will divert rather than eliminate auto traffic but should enhance the quality of life in the inner city and help revitalize decaying areas of the Core. Auto free zones can also reduce carbon monoxide hotspots by dispersing traffic away from congested areas. Parking impacts of auto free zones are nominal, limited mainly to reducing on-street supplies.

b. Parking Demand Measures

Increase in Current Parking Rates: This measure is applicable in communities where parking is largely supplied by local government parking districts. In communities where the vast majority of parking is provided by private operators, governments will probably have little ability to increase rates. The legislation required to obtain this control could probably not be obtained at least in the short term. Rates can also be effectively raised through increased taxes on parking lot operators. However, experience in San Francisco with a 25 percent parking tax indicated that only part of the tax was passed through and that the number of commuter trips diverted was negligible.

Parking Surcharge: Although a surcharge is within the legal powers of all local communities under provisions of the Clean Air Act and surcharge income might be used to reduce the transit deficit, a surcharge is politically very sensitive and would probably not be applied unless required by Federal law. Suburban residents who work in the CBD have viewed this measure as a form of "commuter tax." In terms of its effectiveness, a parking surcharge is the same as raising parking rates. A $1.00 rate hike according to the diversion curves would reduce auto trips to the CBD by 15 percent. Both surcharges and rate increases will only be effective in reducing auto trips if residential area spillover is adequately controlled.

Elimination of Employer and Rent Subsidies: Subsidies provide incentives to use automobiles for commuting trips. An end to employer subsidization results in new out-of-pocket expenses for employees even if salaries are raised to compensate for parking payments. This direct payment eliminates the hidden cost of parking and places transit in a more competitive position. Governments in the region cannot directly change the policies of private business firms. However, to encourage the elimination of the practice voluntarily:

- a public relations effort by the District and County governments would show what they have done to reduce auto commuting by their own employees;
- the City or County could directly request that private businesses reduce subsidies as a way of saving energy and reducing congestion and air pollution.

This same form of "moral suasion" would probably be needed to eliminate Federal government subsidies. A detailed discussion of the Federal government's parking policies is found in Chapter V and shows that, while preferential carpool parking has been instituted, little other effort has been made to raise low cost parking to commercial levels to divert more commuters to mass transit.

The elimination of commuter parking subsidies from rents is difficult to implement unless local governments obtain the legal powers to control rates in private parking garages. At the present time, parking rates in most garages favor long term parkers, such as commuters, over short term parkers by charging low all-day rates or using monthly discounts. Rental income helps recover the capital investment in parking facilities. Local governments could require an altered rate structure as a condition for licensing, but such a move would undoubtedly face political opposition by the parking industry.

c. Support Measures

All of the strategies in this study depend to some degree on support measures. These measures are especially valuable because they are inexpensive, relatively easy to implement and, with the exception of enforcement, are positive parking policies rather than negative or restrictive mechanisms.

Carpool Incentives: Carpool incentive programs are designed to utilize the enormous reserve of unused seating capacity in automobiles. Carpool matching programs can be organized and put into effect at a nominal cost and in a short period of time through areawide computer programs. Other carpooling incentives include reduced parking rates, preferred space locations and reserved spaces for carpool parking. Carpools can ameliorate the impact of rate increases or supply restraints.

Enforcement: As other parking measures begin to take effect, drivers will seek to avoid higher prices by parking illegally. Strict enforcement is vital to discourage illegal parking. Important elements in strict enforcement are reciprocity between jurisdictions in convicting violators, adequate personnel, an automated parking violation information system to allow on-the-spot detection of repeaters, severe enough fines to discourage violations, and the successful collection of fines.

Secure Bicycle Parking: This measure applies to provision of secure bicycle parking at transit stations, major office buildings, and other important destinations. The type of facility could be lockers or racks under surveillance. Because of serious theft problems, many persons will not ride and park bicycles in current facilities. Private garage operators could also be required by local government action to provide a percentage of spaces for secure bicycle parking.

Information Programs: Information programs can range from acquainting commuters with the availability of fringe parking lots to requesting that major employers distribute information to all employees on transportation options.

D. Evaluation of Measures

A detailed explanation of the procedures for technical analysis and evaluation was given in Chapter IV. The following elements were considered in evaluating the parking measures for developing the regional plan.

- Comparison of local and regional goals to determine which measures could effectively meet both. Local goals were considered partial constraints in choosing measures.
- Consideration of the specific parking measures recommended for the target areas. Table 16 shows the short- and long-term measures selected for each target area.
- Evaluation of measures against specific criteria drawn from the regional goals. These criteria shown in Table 17

TABLE 16

APPLICABLE PARKING MEASURES

Measure	District	Silver Spring	Rosslyn	Centreville
Supply				
Provision of Park 'n Ride Lots	short term	short term	N/A	short term
Metro Station Parking	N/A	short term	N/A	N/A
Limitation of Supply through Zoning Changes	short/ long	short/ long	short term	long term
Elimination of On-Street Commuter Parking	short term	N/A	short term	N/A
Residential Permit System	short term	short/ long	short term	N/A
Parking Facility Review	short term	N/A	N/A	N/A
Auto Free Zones	long term	long term	N/A	N/A
Demand				
Increase in Current Parking Rates	N/A	short/ long	short term	N/A
Parking Surcharge	N/A	N/A	N/A	N/A
Elimination of Subsidies to Commuter Parking				
- by employers	short term	N/A	short term	N/A
- by rate structure	N/A	N/A	short term	N/A
Support Measures				
Preferential Carpool Parking	short term	short term	short term	N/A
Enforcement of Parking Measures	short term	short term	short term	N/A
Secure Bicycle Parking	short term	short term	short term	short term
Information Programs	short term	short term	short term	short term

TABLE 17

EVALUATION OF PARKING MEASURES - REGION

Measure	VMT	Transit Use	Economic Dislocation	Cost to Auto Commuter	Cost to Government	Legal Authority	Political	Applicability to Region
1) Park 'n Ride Lots	Decrease	Increase	No	Low	High	Yes	Not Difficult	Yes
2) Parking at Metro station	Decrease	Increase	No	Moderate	High	Yes	Difficult	Yes
3) Limits on Parking Supply thru Zoning	Decrease	Increase	Possible	Low	Low	Yes	Not Difficult	Yes
4) Eliminate on-street commuter parking	Decrease	Increase	Yes	High	Low	Yes	Not Difficult	Yes
5) Residential permit system	Decrease	Increase	No	Moderate	Moderate	Questionable	Not Difficult	Yes
6) Parking facility review	Decrease	Increase	No	Low	Moderate	Yes	Not Difficult	Yes
7) Auto free zones	No Change	No Change	No	Low	High	Yes	Not Difficult	Questionable
8) Increases in Parking Rates	Decrease	Increase	Yes	High	Low	Questionable	Difficult	Questionable
9) Parking surcharge	Decrease	Increase	Yes	High	Low	Questionable	Difficult	Questionable
10) Eliminate parking subsidies by: - employers - rate/time	Decrease Decrease	Increase Increase	Yes Yes	High High	Low Low	No Questionable	Difficult Difficult	Yes Yes
11) Preferential Carpool Parking	Decrease	Increase	No	Low	Low	Yes	Not Difficult	Yes
12) Enforcement	Decrease	Increase	No	Moderate	Moderate	Yes	Not Difficult	Yes
13) Secure Bicycle Parking	Decrease	Increase	No	Low	Low	Yes	Not Difficult	Yes
Information grams	Decrease	Increase	No	Low	Low	Yes	Not Difficult	Yes

include the legal, political and institutional applicability of the measures as well as their socioeconomic impacts and their effectiveness in reducing vehicle miles traveled. The criteria used were:

- VMT - impact on vehicle miles traveled;
- Transit Use - impact on Metro ridership;
- Economic Dislocation - harmful socioeconomic impacts on any population subgroup;
- Cost to Auto Driver - severity of the parking price increases;
- Cost to Government - direct costs required to implement program or construct facilities;
- Legal Authority - if presently held or reasonably attainable by governments;
- Political - implementability in light of anticipated reaction of local elected officials;
- Applicability to Region - summary of evaluation of measures indicating whether they deserve further consideration for the regional plan.

As a result of this evaluation procedure, it was possible to determine which measures were most applicable regionwide. The results are summarized in the last column of Table 17. The recommended measures are combined into four strategies and evaluated quantitatively as part of the regional plan in Chapter VII.

CHAPTER VII

THE REGIONAL PLAN

A. Introduction

Those parking measures described in the preceding chapter which were applicable to the region were grouped into four strategies; these were combined to form the regional plan:

- Residential permit systems and limitations of communter on-street parking
- Increased parking rates and preferential carpool parking
- Transit support through additional park 'n ride lots
- Zoning and land use controls.

This chapter describes these strategies in detail and estimates their effectiveness in reducing auto driver trips. These measures are not recommended as specific programs which can solve the Washington metropolitan area's parking problems. They are meant to be illustrative of the general types of measures which can be applied to achieve regionwide parking goals. Likewise, the numerical impacts assigned to each measure are indicators only of their relative effectiveness in reducing auto driver trips.

B. Strategy #1: Residential Permit Systems and Limits on On-Street Commuter Parking

1. Applicability

This strategy is designed to restrict supply and consists of two measures: elimination of on-street parking and installation of a residential permit system. Before applying pressure to auto commuters, one must figuratively close the escape hatch. In parking management terms, this means eliminating free and available on-street parking spaces. This measure has a dual purpose; residential areas would be protected from the increased number of auto commuters who would seek cheaper parking if commercial rates were raised and the cheapest form of parking, free on-street spaces, would be eliminated.

This is an extremely powerful measure because it carries a "double whammy." By eliminating free on-street parking as an alternative, those commuters who were most price sensitive (they are probably not subsidized) and willing to walk the extra few blocks to get free parking would have that alternative closed. These parkers must pay commercial rates as auto drivers or carpoolers, or switch to transit. The portion choosing not to switch to transit would begin competing for the cheapest spaces available in the CBD. Parking garage owners recognizing the increased demand for the limited supply could raise rates and still fill their parking lots. Thus, those people who formerly parked in free on-street spaces would now have to pay commercial rates plus they would add to the demand pool which would presumably cause an increase in those commercial rates.

2. Estimation of Trip Reductions

This strategy may eliminate up to 14,500 auto driver trips by 1980. As free on-street spaces are restricted to short-term parkers and residential permit programs close the areas of greatest spillover, many auto drivers will be diverted to carpools or transit.

The parking spillover problem depends on two factors. First, a dense employment center must be present. In these areas, parking is normally provided at a fee because the land is valuable and limited. Second, free on-street parking usually provided in a lower density residential area must be in proximity to part of the employment center to accept spillover. To estimate the number of trips affected, 28 dense employments centers in the region with employment greater than or equal to that in Silver Spring were identified. Employment for 22 of those areas in Rings 0-4 was projected for 1980 and 1990 to estimate potential spillover problems. When spaces were eliminated, the diversion curve in Figure 6 was used to predict the reduction in auto driver trips.

3. Implementability

The regional parking plan proposes residential/on-street parking restrictions inside the Core area and in dense employment centers elsewhere in the region. The mechanisms for implementing this measure would include a residential parking permit program similar to that in effect in D.C.; elimination of on-street spaces in commercial areas, introduction of short-term parking time limits and better enforcement.

Residential parking bans have been approved in the District but have run into legal problems in Arlington. (Appendix A includes a copy of the D.C. ordinance). The regional working group would develop a model ordinance and criteria for application. The process for applying this ban might include public hearings in the neighborhoods where a parking ban was to be instituted or a requirement for local approval.

C. Strategy #2: Increased Parking Rates and Preferential Carpool Parking

1. Applicability

This strategy affects parking demand by raising auto commuter parking rates. The applicable measures include increasing parking

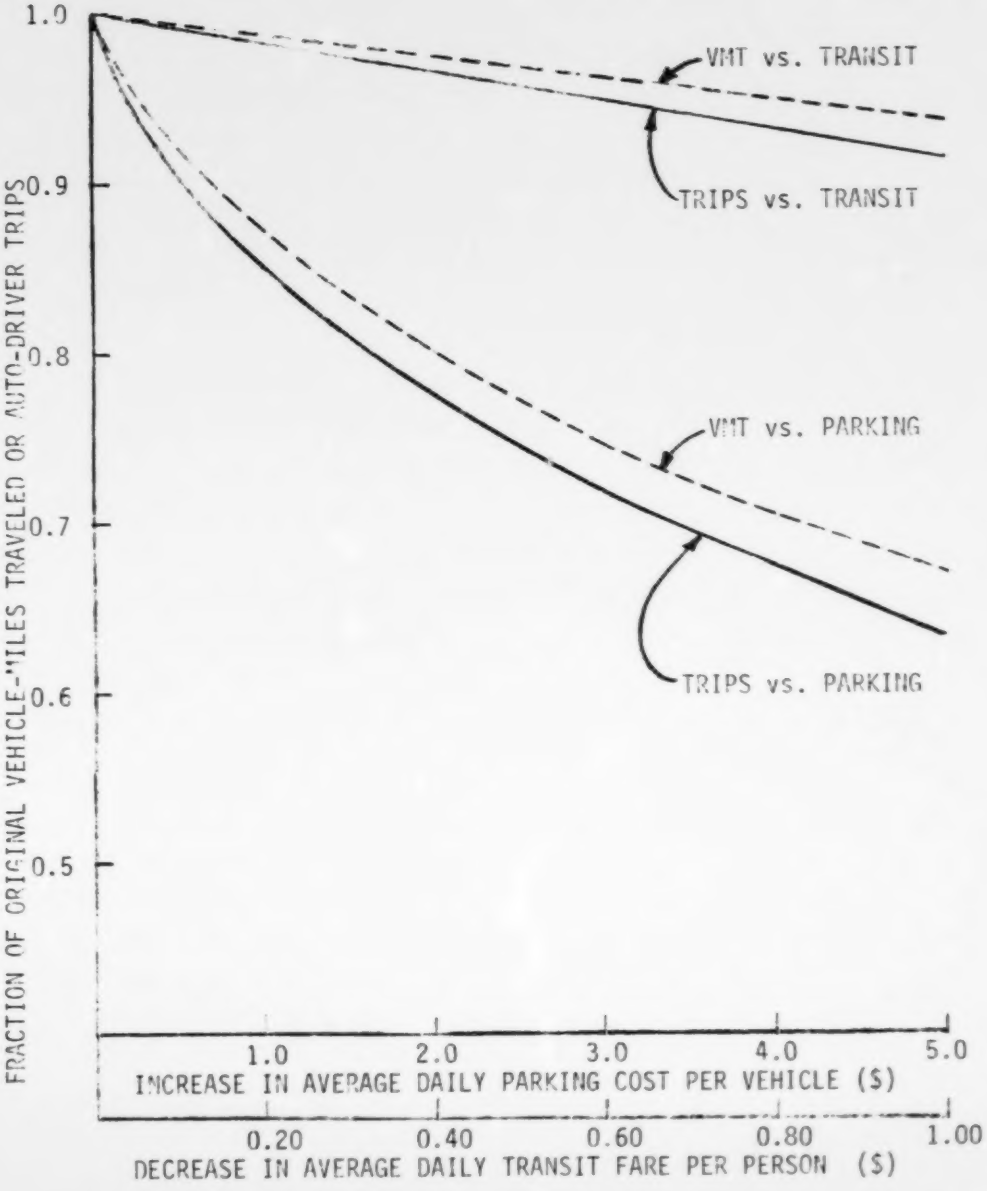


FIGURE 6. DIVERSION OF AUTO USE AS A FUNCTION OF ECONOMIC INCENTIVES

prices through taxes or local surcharges, eliminating subsidies by employers and by rate structure, and providing preferential treatment for carpools. These measures would serve as cost and convenience disincentives for the single auto driver.

The availability of cheap parking acts as a tremendous incentive to auto commuting. Employer subsidies, a rate structure that favors long-term parking (subsidized by building rents), parking lots that do not reflect the value of the land being occupied and publicly funded garages all support auto commuting. This strategy would raise auto commuter parking rates by raising prices and eliminating subsidies.

Five possibilities for increasing rates are immediately obvious: a voluntary reduction of employer subsidies, a voluntary reduction of rent subsidies, restriction of parking supply to allow rate increases, taxation of parking receipts which would be tied inversely to rate schedules, and a surcharge applied selectively. In short, the objective would be to raise the cost of parking to long-term parkers through any method that the jurisdiction felt applicable.

2. Estimation of Trip Reductions

To evaluate the effectiveness of the measures in reducing auto trips requires several assumptions:

- average government rates are assumed to increase to $40 per month in Ring 0 and $20 per month in Ring 1 and beyond;
- the percentage of private employees with subsidized parking decrease from 50 percent to 25 percent;

- the average auto occupancy rate for Federal carpools increases from 1.5 to 2.6 persons;
- diversion curves indicate the number of auto driver trips eliminated due to price increases;
- commuters affected by the measures are diverted to carpools or transit in proportion to the existing modal split.

These assumptions, used in the impact analysis, are conservative because the proposed measures are difficult to implement and rely on the voluntary cooperation of employers. Despite this, applying these assumptions, 46,000 auto driver trips could be eliminated by 1980.

3. Implementability

These rate increase measures rely heavily on voluntary participation by private and public employers. A re-education program will be required for both auto commuters and employers. This, however, may be insufficient to raise parking rates to the point where transit becomes an attractice alternative. Once people have gotten used to parking being cheap, it will be very difficult for them to accept the fact that the real cost may be 2-3 times what they are currently paying.

Alternatively, tax or surcharge measures may be used but these also face great difficulties in implementation. A regional committee consisting of members of the local jurisdictions could determine what the "real cost" of parking is under various circumstances and using guidelines try to insure that rates reflect these values.

D. Strategy #3: Transit Support Through Additional Park 'n Ride Lots

1. Applicability

This strategy combines two measures: additional park 'n ride lots for buses (fringe lots) and additional Metro station parking. Data from other cities with Metro rail type facilities indicate that the availability of park 'n ride lots is integrally tied to the success of rapid transit. WMATA will provide only 37,000 park 'n ride spaces although they estimate demand at 103,000 spaces. As a result, 39,000 riders will be lost. Political decisions were made as to where park 'n ride lots would be provided, in which communities, and how far from the Core. Decisions on parking rates have also been tied to the political process.

Evidence in Rosslyn and Silver Spring suggest the park 'n ride facilities may be insufficient for Metro demand. In fact, insufficient spaces could serve as a barrier to achievement of Metro rail ridership projections. Metro parking currently planned will be paid for by WMATA, however, local jurisdictions can supply additional parking. Through the regional parking management planning process, additional parking could be constructed.

2. Estimation of Trip Reduction

The relationship between auto driver trip reduction and additional park 'n ride lots is precarious. Since many park 'n ride transit patrons now park in residential areas, park 'n ride lots could serve to concentrate these people at an additional expense to the community. In addition, former feeder bus patrons might be induced to drive. Presumably though, some additional transit patronage would result from former auto drivers who would ride transit because of convenient park 'n ride facilities.

To estimate trip reductions due to the addition of new park 'n ride lots, recommendations made by WMATA for additional lots were used. As of 1972, 21 fringe parking lots (6,000 spaces) were available in the Washington area, occupied at 50 percent capacity. Occupancy rates have increased and by 1980 all spaces are assumed to be filled. The WMATA study on "Integrated Metrobus Services" recommended that 5,700 spaces be built at non-Metro rail corridor locations for bus service. These 5,700 spaces would be located in eight sites in Montgomery and Prince George's Counties as well as in Northern Virginia. Since suburban lots have generally achieved higher than average occupancy rates, an occupancy rate of 75 percent was assumed.

Although in Rosslyn and Silver Spring demand was clearly present, WMATA policy has been not to provide any Metro parking in the inner rings, but to construct parking facilities in the suburbs. Therefore, no credit was taken for additional Metrorail park 'n ride spaces. Providing enough parking to maintain the ridership Metro estimates it would otherwise lose would significantly reduce auto driver trips.

3. Implementability

Through regional agreements paralleling WMATA, it would be possible for jurisdictions to finance collectively additional parking. Original WMATA parking allocations have been steadily cut back as residents protest construction of new lots. A formula could be developed by a regional organization allocating fringe parking based on land, transit availability, employment characteristics, etc. This would have to be further investigated by the local jurisdictions.

E. Strategy #4: Zoning and Land Use Controls

1. Applicability

This strategy incorporates two types of measures: zoning and land use controls, with facility reviews potentially incorporated into the zoning decision process. These are the most powerful measures suggested since they influence future growth patterns.

Zoning codes are the traditional tool for managing parking by specifying the minimum number of spaces which developers must provide. Land use planning as the determinant of allowable types of development (i.e. high-rise, single family dwelling or commercial) also largely determines parking supply. Traditionally, zoning measures attempt to insure an adequate supply of parking to prevent spillover into neighboring development or public streets. However, zoning measures should begin to reflect the newly emerging regional goals of air quality improvement, energy conservation and transit support.

In less developed areas like Centreville, land use and zoning measures are particularly important. The basic land use plans will have a great impact on auto usage in future development. For example, if zoning or land use planning is oriented towards mixed uses of land, then dependence on automobiles for commuting can be greatly reduced.

2. Estimation of Trip Reduction

Savings from zoning changes were estimated by assuming that the ratio of employees per space in Rings 0 and 1 increased from 3:1 to 4:1 for all future employment growth. By 1990, 33,000 less spaces would be constructed with approximately 100,000 trips eliminated.

Data from Energy, Land Use, and Growth Policy: Implications for Metropolitan Washington was used to quantify the impact of alternative development patterns. The report presents "wedges and corridors" and "transit-oriented" growth patterns. In the "transit-oriented" scenario, employment and population growth occurs primarily in Rings 2-5 while in the "wedges and corridors" scenario, substantial growth also occurs farther out in Rings 6 and 7. This transit oriented growth pattern eliminates an additional 85,000 work-related trips.

3. Implementability

Reduction or elimination of minimum parking requirements under zoning ordinances could be done by a regional committee composed of local jurisdictions. This committee would set up criteria for different areas specifying or suggesting what levels of zoning should be applied for parking.

Generally, new institutions are not recommended for implementing these long-term measures. Rather, the existing planning process should be modified so that parking management becomes part of the land use and transportation planning processes.

F. Summary

Table 1 indicates the relative impacts of the recommended parking strategies in eliminating auto driver trips. By far the greatest reduction can be expected from zoning and land use changes, especially long range alterations in land use development patterns to channel growth into more transit and energy efficient configurations. Trip reductions can also be achieved more immediately through reduced zoning requirements for parking supply in new CBD development.

The second largest decrease in auto driver trips can be achieved through parking price increases and preferential carpool parking. This strategy relies heavily on the voluntary reduction of parking subsidies and may be difficult to achieve.

Moderate impacts can be gained through maximum development of park 'n ride lots for bus service in non-rail corridors. This measure assumes that express bus service will accompany fringe lot development to make transit usage attractive. Additional rail park 'n ride lots would substantially increase the impact of this measure but insufficient data was available to quantify the impacts.

Less important in numbers but vital to the success of other measures are the residential permit systems and the limits on on-street commuter parking in the Core and outlying major employment centers. The success of this strategy may have a more visible effect on congestion and the livability of urban areas than any other, yet cause the least amount of disruption. For this reason, it is highly recommended as an initial first step in any parking management plan.

CHAPTER VIII

SOCIOECONOMIC IMPACT OF THE REGIONAL PLAN

A. Introduction

The proposed regional parking management plan will support a change in the lifestyles of Washington area commuters that has already begun to occur. When local jurisdictions agreed to support Metro, they implicitly agreed to limit the role of automobiles as commuter vehicles in favor of rapid rail transit. Since then, the addition of express bus lanes, preferential carpool parking, fringe lots, etc. represent further incursions against the wastefulness of one man-one car commuting.

The socioeconomic impact analysis is divided into four major sections. These measure the plan's impact on:

- various population subgroups
- auto commuters
- transit
- economic growth and development.

B. Impacts on Population Subgroups

The recommended regional parking management plan will affect eight different population subgroups. These subgroups and the associated impacts are shown in Table 18. The table indicates that most of the negative impacts fall on auto commuters, however, these additional burdens are not penalties. The increased auto commuting costs simply reflect the elimination of

TABLE 18

SOCIO-ECONOMIC IMPACT

ELEMENTS OF PLAN

	Impacted Subgroups	1 Residential Parking Restrictions	2 Increased Parking Rates	3 Zoning and Land Use Planning Modifications	4 Transit Support
1)	Auto Commuters	Decrease in Free Spaces	Increase in Parking Costs	Decreased Parking Supply	More Inner City Spaces Available
2)	Transit Commuters	Decrease in on-street Park-N-Ride Spaces	Potential Increase in Transit Demand, Fares and Service	Increased Transit Demand	Better Auto Access to Transit
3)	Commercial Developments	Increased Demand for Tenant Parking	Lower Losses on Existing Spaces	Potentially Lower Parking Requirements	Lower Parking Requirements
4)	Employers	A Few May Need To Find Parking	Potential Savings Through Decreased Subsidies	Less Need to Provide Parking	Less Need to Provide Parking
5)	Residents	More Available Space Near Home	No Impact	Less Auto Traffic in Residential Areas	Less Spill-over Into Adjacent Areas
6)	Store SW/ Shoppers	More Demand for Available Spaces	More Short Term Parking Available	Better Non/ Auto Access To Shopping	Additional Income From Dual Use of Shopping Center Spaces
7)	Local Governments	Decreased Metro-Rail Defecits	Decreased Metro-Rail Defecits	Better Use of Taxable Land	Decreased Metro-Rail Defecits
8)	Parking Lot Owner/Operations	Able to Charge Higher Prices	Potentially Lower Demand and Higher Profits	Less Demand for Commercial Parking	Impact Depends on Type of Parking Allowed

subsidies and the encouragement of less auto-oriented future development. The impact will fall most heavily upon "captive" low income auto commuters (i.e. those unable to switch to transit or carpools). For example, a government secretary earning $7,000 a year who lives far from the Core and must drop off children at a day-care center could be seriously impacted. Increasing parking fees from zero to $40 per month would reduce her pre-tax disposable income by 7 percent. Special exemptions or variances for these situations would have to be investigated at the regional, local or individual employer level.

The impacts on transit commuters will be mixed. Potentially, they could be paying higher prices, getting better service, but also having to cope with more crowding. This might mean standing on buses or trains that formerly had extra seats, but having to wait a shorter period of time before the next bus or train arrived. This dichotomy occurs because most of the measures which negatively impact auto commuters increase the demand for transit. With increased demand, transit can charge higher fares and theoretically provide better service. In the Washington metropolitan area, the tremendous capacity available through Metro rail should alleviate the problem of crowding or the cost of adding more buses which could arise with the implementation of a parking management plan at this time.

Commercial developers should benefit as long as the parking plan is applied regionwide. Under these circumstances, developers would face similar predicaments. Tenants, unhappy over increased parking costs and perceived supply shortages, would have few alternatives. The whole region would benefit if the cost of commercial development decreased because zoning ordinances required less parking.

Employers would benefit to the extent that their parking subsidy payments decreased due to increased carpooling or transit usage. Land formerly devoted to employee parking could be put to more profitable uses.

Residential areas adjacent to commercial areas would be spared the problems of spillover. In addition, the use of vehicle free zones in shopping areas would aesthetically improve residential and commercial areas.

The case studies already demonstrated the need for protecting shopping trips. Stores and shoppers will benefit from the proposed plan to the extent that spaces formerly occupied by long-term commuter parkers would now be free to meet the relatively short-term demands of shoppers.

Local governments will benefit in two ways. First, parking measures would decrease Metro deficits by increasing Metro rail ridership. Second, modifications in existing zoning regulations and less auto-oriented land use planning would allow land to be used for functions which yield more tax revenues.

The impact on parking lot owners/operators depends upon the future supply-demand equilibrium. The proposed measures should decrease demand for commuter parking while allowing operators to charge higher rates by eliminating free on-street and residential spaces. The San Francisco experience with a 25 percent surcharge indicated that if the revenue from price increases had gone to the parking lot owners rather than the city, lot owners would have profited.

C. Impact on Auto Commuters

Many aspects of auto commuting are paid for by subsidies or hidden costs. Parking represents one area which is now heavily subsidized. The proposed plan would gradually force auto commuters to pay the full cost of parking which for many will double or triple auto commuting costs.

The out-of-pocket costs for commuting are the price of gasoline, oil and maintenance on the automobile. These costs are approximately $.07 per mile. A 20-mile per day round trip commute, therefore, would cost $1.40 plus parking. Interviews with auto commuters on Shirley Highway indicated that 50 percent of them paid nothing at all for parking and 80 percent paid $1.00 or less. EEA's surveys in D.C. and Rosslyn indicated that over half the auto commuters had subsidized parking. Since a round-trip bus ticket now costs about $1.40 per day, the costs of auto and bus commuting are approximately the same for over half of the commuters.

Even without employer subsidies, auto commuters do not pay the full price of parking. Parking lots also provide a kind of subsidy. Parking lot owners attempt to reduce the losses incurred while holding land for development by charging enough to help cover taxes and land investment costs, but rarely succeed in making a profit or even fully covering expenses.

Garage spaces are partially subsidized by rents and employer contributions. The cost of land coupled with the high costs of construction would require charging $60-$70 per month for parking. Realizing this, developers competing for tenants have chosen to build only enough parking to service building tenants and to subsidize parking costs through office rents. This situation developed because parking is a relatively competitive market. Commuters will walk across the street or down the block to save on parking costs. Consequently, parking garages must price competitively. The presence of heavily subsidized government parking, the abundance of lots which charge less than full costs, and the availability of free parking in residential areas limit the amount which garage owners can charge for parking. Once the practice of subsidizing parking costs with office rents became widespread, new developers followed this pattern and the current situation developed.

The proposed plan would raise the costs of parking for most commuters. The measures used would include voluntary elimination of employer subsidies, elimination of free on-street parking and parking in residential areas and, where necessary, parking taxes applied by the local jurisdictions. For those auto commuters now paying only the $1.40 per day out-of-pocket costs, full price parking could double or triple their daily commuting expenses. "Captive" commuters, unable to carpool or switch to transit, would bear the full cost of the proposed measures.

D. Impact on Transit

Automobiles compete with transit for commuters. Historically, most people walked to work or commuted by transit. However, between 1950 and 1956, transit ridership in Washington, D.C. decreased 50 percent. During the same period, widespread automobile ownership, growing affluence, improved roads, and suburban population growth shifted the modal split drastically towards auto commuting. Further deterioration in transit's position occurred all during the 1960's until, by 1970, three-fourths of the commuters in Washington, D.C. got to work by auto.

Shifting community priorities has resulted in a multi-billion dollar investment to revitalize transit commuting in the D.C. area. Parking management can support transit by:

- providing fringe lots near line haul bus and rail stations making it easy for commuters to drive short distances to a convenient transit collection point; and
- raising parking rates to decrease transit costs relative to auto commuting costs.

In creasing parking rates would also allow transit fares to be increased with less diversion back to automobiles.

Washington, D.C. has committed $4.5 to $6 billion to a Metro rail system. Due to unanticipated cost increases, Metro will never be able to cover operating and capital costs. Minimizing losses, therefore, has become an acute problem because some local jurisdictions are having difficulty paying their share of the deficit.

1. Fringe Lots

Local jurisdictions delegated responsibility for Metro-related parking management decisions to WMATA (Washington Metropolitan Area Transit Authority). They recognized that parking policies would affect the success of the rail system. Since some communities did not want to provide Metro parking lots, the decision affecting size and location of lots had to be made regionally through compromise and negotiation. The regional plan would follow a similar pattern in extending the number of fringe lots. The Silver Spring and Rosslyn case studies identified significant needs for additional park 'n ride spaces. Even WMATA acknowledges that 37,000 riders may be lost daily by 1992 because of insufficient parking.

The negative socioeconomic impact of fringe lots for buses may be minimized by using existing shopping center parking lots. This is an ideal set-up because peak parking demand for commuters occurs during those hours of the day when the demand for parking by shoppers is relatively low. In the evening and weekend hours when shopping demand peaks, commuter transit parking demand is low. Local communities have tremendous "horse-trading" power with developers and can use zoning variances and tax allowances to secure fringe lot spaces. Local communities can also construct fringe lots.

Conceptually, fringe lots are the result of moving parking spaces from the Core to the periphery of the region. A recent meeting of transit personnel from San Francisco, Toronto and other major urban centers stressed the importance of moving these spaces out to fringe lots. These communities found that availability of park 'n ride spaces for bus and rail commuters was vital to the success of their transit systems.

2. Transit Deficits

The price of parking is integrally related to transit deficits. As discussed previously, the cost of auto commuting and transit commuting is approximately equal when parking is provided free. The regional plan would increase the modal split to transit and at the same time allow transit fares to be increased without diverting as many transit riders back to autos.

The measures suggested in the regional plan will increase transit ridership by 20,700 by 1980 and 123,000 by 1990. These riders would contribute about $10 million per year in additional revenue by 1980 and $60 million by 1990. These revenue increases would substantially reduce the projected Metro operating deficits.

E. Impact on Economic Growth and Development

Parking management affects the location and form of new development. The land use planning process determines how various land parcels should be zoned; and the zoning process sets minimum parking requirements for each land use. Parking is, therefore, already an integral part of the land use and zoning process.

The target area studies indicate that communities in the D.C. area compete for new development. Developers choose those areas which seem to offer the highest rate of return on their investment. Since many developers may see parking restrictions as a potntial threat to profitability, they could avoid those areas instituting the strictest parking measures.

The target area studies, however, indicate that economic attractiveness of an area probably overrides its parking policies in affecting developers' decisions. A change in parking management policy in Rosslyn, for example freezing parking at its present level, could decrease the attractiveness of the area for new developers. However, the inherent attractiveness of the area, its proximity to D.C., tax rate, existing development and access to Metro would probably allow it to grow despite a parking freeze. This is especially true if similar parking measures were imposed in other parts of the Core.

Including parking management in the zoning and land use decision making processes to reduce reliance on the automobile is the most powerful strategy proposed in this plan. In the D.C. Core, a freeze on future parking would save developers $30 million r year by 1990. In Centreville, a decision to encourage high nsity townhouse development as opposed to single family unit rawl would allow transit to compete with automobiles as the imary form of commuting.

Parking management would not become a separate function; it ould be integrated into the regional and local community land se, transportation and air quality planning processes. The im-act of these measures would therefore be felt over a longer eriod of time and have much milder socioeconomic impacts than he short-term measures.

CHAPTER IX

AIR QUALITY* AND ENERGY IMPACTS

A. Present Air Quality

In 1974, the air quality standards for photochemical oxidants, carbon monoxide and nitrogen dioxide were all exceeded in the Washington, D.C. area. Maximum concentrations of carbon monoxide and photochemical oxidants have been consistently over twice the applicable Federal ambient air quality standard. Nitrogen dioxide levels were only slightly over the standard in 1974.

Table 19 shows a summary of maximum observed pollutant concentrations for these auto related pollutants for the National Capital Air Quality Control Region.

Generally maximum concentrations of auto related pollutants have changed little over the last three years in the D.C. area. One-hour CO concentrations dropped slightly in 1974 and are about 15 percent over the standard. Violations of the eight-hour and one-hour concentrations have consistently been observed in the District of Columbia apparently due to the higher concentration of vehicle use in this area than the suburban areas.

It is somewhat surprising that levels of carbon monoxide in Washington have not dropped off over the last several years. In other metropolitan areas saturated with high auto use, CO levels have been dropping due to emission controls on new automobiles. The lack of an observable reduction in CO levels in D.C. may be attributable to continued increases in vehicle traffic and/or atypical meteorlogical stagnation patterns during the 1972-1974 time period.

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* Appendix C presents the general analytical procedure used in this study to assess the air quality impact of a parking management plan.

TABLE 19

AIR QUALITY REGIONAL SUMMARY

POLLUTANT (Averaging Time)		MAXIMUM CONCENTRATION $\mu g/m^3$	LOCATION
Carbon Monoxide			
(1-hour)	1972	-----	
	1973	49,000	District of Columbia, Core
	1974	46,000	District of Columbia, North
Primary Std.		40,000	
Carbon Monoxide			
(8-hour)	1972	24,000	District of Columbia, East
	1973	22,000	District of Columbia, East
	1974	26,500	District of Columbia, North
Primary Std.		10,000	
Oxidants			
(1-hour)	1972	400	Prince George's County
	1973	420	Prince George's County & Alexandria
	1974	440	District of Columbia, North
Primary Std.		160	
Nitrogen Dioxide			
(Annual Average)			
	1972	98	District of Columbia, Core
	1973	110	Prince George's County
	1974	110	Prince George's County
Primary Std.		100	

Maximum concentrations of oxidants, which result from atmospheric reactions of hydrocarbons, nitrogen oxides and sunlight, have increased slightly each year over the last three years. Although precursor hydrocarbon emissions of new automobiles are being reduced, the relative importance of other hydrocarbon emission sources and the complex mechanisms of oxidant formation make oxidant control difficult.

High oxidant levels are a regionwide problem in the D.C. area. The oxidant standard is being exceeded at every sampling station in the region. The highest observations are often in suburban areas. This can be attributed to the time of reaction involved in converting primary emissions into oxidants. During this reaction time, contaminated parcels of air often move away from the source of emissions. In this way emissions on one side of the region can impact oxidant levels on the other side. The general lack of reduction in oxidant levels is probably best attributed to continued growth in regionwide vehicle use in the 1972-1974 time period.

In 1973 and 1974 the primary air quality standard for nitrogen dioxide was violated in the Maryland suburbs of Washington, D.C. Like oxidants, nitrogen dioxide may prove to be a regionwide problem. Nitrogen oxide emissions, mostly NO, must be oxidized to form NO_2. During the time of reaction parcels of air mix and travel throughout the region. Because of this nitrogen oxide emissions throughout the region are likely to impact on the areas having highest concentrations of this pollutant.

B. Air Quality Projections

With or without a parking management plan, the future air quality of the entire National Capital AQCR will be a function of the temporal and spatial distribution and magnitude of the various pollutant emission sources. For secondary pollutants such as photochemical oxidants and nitrogen dioxide which are produced from primary hydrocarbon and nitrogen oxide emissions, photochemistry and pollutant interactions are also of importance.

In order to estimate the future change in air quality due to parking management, regionwide emissions inventories should be constructed for CO, hydrocarbons and nitrogen oxides. Tables 20, 21 and 22 give regionwide projections of these pollutants for 1972, 1980 and 1992. These emission projections are based on long range planning studies by COG with extrapolation of data to 1980 as required. The inventories for carbon monoxide and hydrocarbon emissions are both keyed to those periods of the day having the greatest impact on air quality for these pollutants. Morning hydrocarbon emissions react to form high afternoon oxidant levels, and carbon monoxide emissions in the late afternoon and evening are most likely to cause high CO concentrations. Regionwide, automobiles presently account for about 80 percent of CO, 65 percent of hydrocarbons, and 45 percent of nitrogen oxide emissions. As stringent limitations on automobiles are implemented, and the dirtier vehicles are removed from the in-use fleet, the absolute and relative contribution of automobiles to adverse air quality will decrease. These projections do assume high efficiency and effectiveness for future emission controls. To the extent this is not the case (as emission controls have not been totally effective in recent model years), the role of the automobile could be significantly greater and the air quality of region corresponding worse than the figures presented in the remainder of this report.

Detailed emission inventories have not been developed for use in assessing the air quality impact specific to subregions of the National Capital AQCR. Because oxidants and nitrogen

TABLE 20

REGIONAL EMISSIONS PROJECTIONS
CARBON MONOXIDE
tons/peak period[1/]

Emission Source	1972[2/]	1980[3/]	1992[2/]
Automobiles	727 (83%)	175 (48%)	85 (24%)
Trucks & Buses	101 (11%)	134 (36%)	192 (55%)
Others	49 (5%)	58 (16%)	72 (21%)
TOTAL	877	367	349

1/ Peak period = 2-10 p.m.

2/ From COG Technical Report #3, June 1974, "Air Pollution Emissions Analysis of Long Range Transportation Plans for the National Capital."

3/ Extrapolated values.

TABLE 21

REGIONAL EMISSIONS PROJECTIONS
HYDROCARBONS
tons/peak period 1/

Emission Source	1972 2/	1980 3/	1992 2/
Autos	41.2	22.0	6.7
	(70%)	(57%)	(27%)
Trucks & Buses	6.0	7.3	9.4
	(10%)	(24%)	(40%)
Others	12.2	9.1	8.7
	(20%)	(19%)	(35%)
TOTAL	59.4	38.4	24.8

1/ Peak period 6 a.m. to 9 a.m.

2/ From COG Technical Report #3, June 1974 "Air Pollution Emission Analysis of the Long Range Transportation Plan for the National Capital."

3/ Extrapolated based on EPA projections of automotive emission factors and general trend projections of other sources.

TABLE 22

REGIONAL EMISSIONS PROJECTIONS
NITROGEN OXIDES
tons/day

Emission Source	1972[1/]	1980[1/]	1992[1/]
Autos	27.3	8.7	4.34
	(45%)	(16%)	(6%)
Trucks & Buses	6.1	10.4	15.15
	(10%)	(19%)	(21%)
Others	27.4	35.2	52.41
	(45%)	(65%)	(73%)
TOTAL	60.8	54.3	71.90

1/ Automotive projections based on EEA's emissions projections model and 1992 COG estimates, remaining trends developed from Draft COG Report "1985 Air Quality."

dioxide both require chemical formation reactions in the atmosphere before high concentrations are observed, both are considered regionwide problems and are normally not dealt with at the subregional level. Air quality projections for these two pollutants based on overall regional conditions are shown in Table 23.

Carbon monoxide is, however, amenable to localized impact analysis. Sample localized analyses are presented in the case studies. For the purpose of assessing the regionwide plan, however, only general regionwide emission trends, assuming source homogeneity, and projecting reductions in CO based on the regionwide emission inventory will be used. Projected maximum CO levels based on the overall regional emission projection are also shown in Table 23. The projection indicates that a CC 8-hour standard will be met in the National Capital AQCR during the 1980's.

C. Air Quality Impact of Parking Plan

Although vehicle miles travelled (VMT) is often used as a surrogate for emissions reductions, emissions of CO, hydrocarbons and nitrogen oxides from automobiles are in fact a complex function of the frequency and manner in which the vehicle is operated. Certain emissions due to fuel evaporation are independent of operation. Others such as high hydrocarbons and carbon monoxide emissions while the engine is cold are a function of the number of trips and duration between trips. Running emissions are in turn a function of both the miles travelled and the speed of travel. Projection of emission reductions due to parking strategies is further complicated by the fact that each year and make of car will have a specific system for emissions control and specific emission characteristics which can change with vehicle age, level of maintenance and the accumulation of mileage.

TABLE 23

PROJECTED OXIDANT, NITROGEN DIOXIDE AND CARBON MONOXIDE LEVELS BASED ON REGIONWIDE EMISSIONS PROJECTIONS WITHOUT PROPOSED PARKING MANAGEMENT EFFORTS IN EFFECT*

Year	Carbon Monoxide 8-hr average $\mu g/m^3$	Photochemical** oxidants peak hour $\mu g/m^3$	Nitrogen Dioxide*** annual average $\mu g/m^3$
1972	24,000	400	98
1980	10,000	310 (260)	87
1992	9,500	210 (168)	115
Federal Ambient Air Standard	10,000	160	100

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* Assumes 1972 to be a representative air quality year. Constructed from emission inventory and air quality data presented elsewhere in study.

** Oxidant values reflect the use of EPA's non-linear Appendix J hydrocarbon/oxidant relationship. Use of a linear approach will give greater improvements in air quality. Values in parentheses reflect use of a linear relationship.

*** Nitrogen dioxide levels are assumed to be proportioned to total nitrogen oxide emissions.

In spite of these technical complications, one must have a feel for the air quality significance of a parking management plan. To do this, an estimate has been made of the short term and long term plans' effects on miles driven and trips made in the National Capital AQCR in 1980 and 1992. The analysis focuses on the periods of the day most important to high concentrations of the identified pollutants: 6 to 9 a.m. for high oxidant levels due to morning hydrocarbon emissions, 2 to 10 p.m. for high eight-hour average CO concentrations, and a full 24 hours for the annual average NO_2 concentration. Since emissions are both a function of trip length and frequency, both auto use "indicators", number of trips and vehicle miles travelled, were examined for 1980 and 1992.

Table 24 shows the distribution of regionwide travel in the 1980's which was used in predicting air quality impact, given by general type of trip and time of day.

As presented in Section V , the impact of parking management has been analyzed in three elements: the reduction in auto use due to existing parking measures in the Washington area, the reduction due to proposed measures aimed directly at parking use, and the long-term impact of land use and zoning measures. Existing and proposed measures are designed to reduce only work commute trips and non-home based trips dependent upon commuter auto use. The estimated impact of the proposed and existing parking management measures on regionwide commuter and non-home based trips is shown in Table 25.

Based on these figures, one can estimate the impact of regionwide parking management on total auto usage. Table 26 shows the estimated reductions in trips and VMT for 1980 and 1992 for the three time period of concern.

TABLE 24

ASSUMED DISTRIBUTION OF AUTO DRIVER TRIPS 1980 and 1992

Trip Type	Percent Trips	Percent VMT*
Home-to-work, Core	7	11
Home-to-work, Non-Core	21	26
Home-to-shopping	20	14
Home-to-other	32	34
Non-Home based	20	14

TEMPORAL DISTRIBUTION OF TRIPS

	Morning Peak 6-9 a.m.	CO Peak 2-10 p.m.	Remainder of day
Home-to-work	45%	50%	5%
Home-to-shopping	5%	45%	50%
Home-to-other	10%	50%	40%
Non-Home	10%	50%	40%

* Assumes core commute - 9 miles, non-core commute - 7 miles, shopping - 4 miles, other - 6 miles, and non-home based - 4 miles.

TABLE 25

PERCENTAGE REDUCTIONS IN AUTO USE DUE TO PARKING MANAGEMENT

	Percent Reduction			
	1930		1992	
	Commute	Non-Home based	Commute	Non-Home based
Existing Measures	2.0%	1.5%	1.4%	1.0%
Proposed Parking Use Measures	1.7%	1.6%	1.2%	1.1%
Proposed Zoning and Land Use Measures	--	--	6.2%	4.2%
TOTAL	3.7%	3.1%	8.8%	6.3%

TABLE 26

REDUCTION IN REGIONWIDE
AUTO USE
BY TIME OF DAY*

	Percentage Reduction			
	1980		1992	
	Trips	VMT	Trips	VMT
6:00-9:00 a.m. (oxidant related peak period)	2.8%	3.0%	6.5%	7.0%
2:00-10:00 p.m. (CO related peak period)	1.7%	1.8%	3.7%	4.1%
Overall 24-hour	1.7%	1.8%	3.7%	4.1%

* Includes impact of existing parking measures and proposed use and zoning measures.

Both the number of trips and number of miles are useful surrogates for emissions, the former representing start-up emissions and the latter running emissions. Ten to thirty percent of the auto HC and CO emissions can occur during start-up of a cold engine. As new cars (and associated controls) come into use between now and 1992, this relationship may change but the two figures, trips reduction and VMT reduction, should bracket the range of emissions reductions. For nitrogen oxides, cold start emissions are low and VMT should be a more representative surrogate for these emissions.

Taking into account the relative contribution of automobiles in 1980 and 1992 to total HC, CO, and NO_x emissions as depicted in the COG projections presented earlier, one can estimate the impact of parking management on air quality. Regionwide reductions in CO levels would be on the order of 0.8 percent in 1980 and 0.9 percent in 1992. These reductions will accelerate achievement and prolong maintenance of the CO air quality standards in Washington, D.C.

Oxidant levels would be expected to drop about 1.5 percent by 1980 and 1.8 percent by 1990. For nitrogen oxides, the reductions would be 0.3 percent in 1980 and 0.2 percent in 1992. Since both the oxidant and nitrogen dioxide standards are projected to be exceeded in 1992, any reduction in the precursors of these pollutants will have some benefit.

These reductions are not large but in regions such as Washington where auto-related pollutant standards will be difficult to attain and maintain, parking management can serve as one of many control strategies to help reduce overall emissions and thereby improve air quality. The big reductions achievable in the 1970's through initial control of all emissions sources will no longer be available in the '80's to further reduce emissions. Emissions reductions on the order of one to two percent are typical of the measure available in this time frame.

One must also keep in mind that the baseline projections developed by COG and used to assess the impact of parking management assume complete and effective attainment of the auto emission standards called for in the Clean Air Act. These standards have yet to be achieved. To the extent they may not be realized in terms of timing or effectiveness, the role of automobiles in regional emissions will increase, the air quality will be worse, and the impact of parking management will be greater.

D. The Energy Impact

In addition to air quality improvements and Metro deficit reductions, the proposed regional parking management plan can potentially reduce energy consumption. Bus and rail are generally more energy efficient commuting modes than private automobiles.

The key variable in assessing relative energy efficiency is the load factor. Table 27 indicates energy consumption per passenger mile for auto and bus for various load factors. Rail is the most energy efficient commuting mode whether operated at full or typical load factors. Auto-drivers diverted to other commuting modes would become bus riders, rail riders (or bus/rail combination), park 'n riders, bicyclists, etc. They would travel

TABLE 27

ENERGY USE FOR URBAN PASSENGER TRANSPORT, 1970

Vehicle	Energy per Passenger-mile (btu's)	Load Factor (%)	Seats per Vehicle
Motor bus	3,700	18*	50
	666	100	
Automobile	8,100	28*	5
	2,270	100	
Electric Rail 1/	2,400	20*	72
	480	100	

* Typical average loading

1/ For the average 1970 rail system at a 20 percent load factor, energy consumption was 4,100 btu's per passenger mile. BART achieves the 2,400 btu consumption rate due to its light weight design and Metro should do likewise.

SOURCE: Hirst, "Energy Implications of Several Environmental Quality Strategies", 1973.

during the peak period when occupancy rates are nearly 100 percent or off peak when marginal energy consumption would be quite low.

For this analysis, the energy consumption impact was approximated by assuming first that the estimated 74,000 trips diverted in 1980 split to Metro bus (36%) and Metro rail (64%) in the same percentages as general ridership in 1990. An auto occupancy rate of 1.4 persons per car was also used for existing passenger trips. Using these assumptions, the energy savings is approximately 3.8 x 10^9 btu's. Converted to gallons of gasoline, this amount to 42,000 gallons per day.

GLOSSARY

Air Quality Control Region (AQCR): A total 247 areas designated by EPA based on jurisdictional boundaries, urban-industrial concentrations, common atmosphere areas and other factors necessary to achieve air quality standards.

Auto-free zone: Section of the CBD reserved for non-auto use: pedestrians, bicycles, mini-buses.

Central Business District (CBD): The "downtown" section of a city containing but not limited to the "Core" (the heart of business, commercial, financial and administrative activity, which is usually the area having the greatest parking demand).

Feeder bus service: High frequency, short route bus service designed to take commuters from home to rapid rail or express bus stations.

Home-to-work trip: One-way trip for the purpose of commuting to or from work. Non home based work trips are mid-day excursions for lunch, business, etc.

Kiss-and-ride: An auto trip where the trip-maker is driven to the transit station and thus does not require parking space.

Long range plan: For the purpose of this study, a parking management plan implementable by 1990.

Measure: Mechanism that allows some form of regulation over parking, usually through supply or pricing. One or more measures make up a parking management plan.

Metro: In this study, refers to the rapid rail service to be provided in the Washington Metropolitan Area, beginning in 1976. (The term Metrobus is used to describe bus transit.)

Modal Split: That portion of the population which travels by various modes (i.e., auto driver, auto passenger, bus rider, walker).

Park and Ride: A bi-modal trip made by auto and bus or auto and rail, where the trip maker is the auto-driver, and thus requires a parking space at or near the transit station.

Peak parking demand: The maximum demand for parking spaces from commuters, shoppers and other visitors to the CBD, believed to occur in Washington between 11 a.m. and 12 noon.

Peak period: The time when most travel is occurring. In the morning this is usually 6-9 a.m. The evening peak period occurs between 5-7 p.m. but the concentration of traffic is less than in the morning.

Short-range plan: For the purposes of this study, a parking management plan that is implementable by 1977-1980.

Spillover: Condition that results when commuters, shoppers and other visitors to the CBD choose to park in residential areas (usually on-street, free spaces) rather than use CBD, parking facilities.

Transportation Control Plan (TCP): Plans developed by EPA for twenty-nine metropolitan areas who otherwise would not have met National Air Quality Standards by the 1975 deadline. The TCP involves a combination of transportation controls to reduce emissions including carpooling, mass transit usage and motor vehicle restraints.

Vehicle Miles of Travel (VMT): A quantity of vehicle usage that acts as a surrogate for vehicle-produced pollution, energy consumption, etc.

Vehicle occupancy: The average number of persons per automobile for a certain area or trip-type.

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APPENDIX A

D.C. RESIDENTIAL PERMIT PARKING PROGRAM

RULES AND REGULATIONS

RESIDENTIAL PERMIT PARKING PROGRAM

By virtue of the authority vested in me as Mayor of the District of Columbia, the following objective criteria is hereby established to be used in evaluating need for restricted parking in a residential area in accordance with Section 82 (c) of Regulation 74-25:

For an area, however big or small, to be eligible for residential permit parking, that area must meet the following criteria:

(1) During any period between the hours of 7:00 a.m. and 6:30 p.m. weekdays, except holidays, the number of vehicles parked (or standing), legally or illegally, on the streets in the area is equal to 70% or more of the legal on-street parking capacity of the area. For purposes of this criterion, a legal parking space shall be 20 linear feet.

(2) During the same period as in Item 1 above, 10% or more of the vehicles parked (or standing) on the streets in the area are not registered in the name of a person residing in this area. For purposes of this criterion, the latest available information from the Department of Motor Vehicles regarding registration of motor vehicles shall be used.

(3) Prior to an area being recommended as a residential permit parking area, the following factors must be considered:

   (a) The clean air requirements of Federal and District air quality plans.

   (b) The possibility of a reduction in vehicle miles traveled.

   (c) The likelihood of alleviating traffic congestion, illegal parking, and related health and safety hazards.

   (d) The proximity of public transportation.

(e) The desire and need of the area residents for residential permit parking and their willingness to bear the associated administrative costs.

(f) The need for parking for periods in excess of two hours for business establishments and the general public for religious, health, or education purposes; and

(g) The need for parking regulation to maintain the stability of neighborhoods.

Interested persons residing in impacted areas may submit written petitions reflecting the majority viewpoint on the program to Mr. Martin K. Schaller, Executive Secretary, Executive Office of the Mayor, Room 528, District Building, 14th and E Streets, N. W. Washington, D. C. 20004.

Walter E. Washington
Mayor

RESIDENTIAL PERMIT PARKING PROGRAM

1. Question: What are the proposed hours of enforcement for the Program?

   Answer: The permit parking restriction will be in effect from 7:00 a.m. to 6:30 p.m., Weekdays, Except Holidays.

2. Question: What effect will the program have on parking in evenings or on weekends?

   Answer: The program will not be in effect at all during these periods.

3. Question: What areas will the program affect?

   Answer: The program is city-wide and will be implemented on a petition basis. All impacted areas will be served.

4. Question: How will citizens know where they can park legally for more than 2 hours?

   Answer: A zone system will be established throughout the city and each impacted area within the zones will be signed to indicate the two-hour limit.

5. Question: How will the zones be established?

   Answer: There will be 8 zones and the boundaries will coincide with existing ward boundaries.

6. Question: How will the stickers be issued?

   Answer: When an area has been approved, stickers can be obtained from the Department of Motor Vehicles.

7. Question: Will there be a charge for the stickers?

   Answer: Yes, but it will be minimal and designed to cover the program's administrative costs. The cost is expected to be between five and ten dollars.

8. Question: Will the program insure residents a parking space in front of their homes?

   Answer: No, but it should provide each resident an opportunity to park in the general vicinity of their home.

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9. Question: Will out of town guests, household employees and visitors be subject to the two-hour restriction?

Answer: Yes, however the Director of the Department of Highways and Traffic is authorized to make provisions for the issuance of temporary parking permits to bona fide visitors of residents of a designated residential parking area.

10. Question: If there are exemptions, who would qualify?

Answer: We are considering exemption stickers for the handicapped and other hardship cases.

11. Question: How will the restriction be enforced?

Answer: The restriction will be enforced by the Metropolitan Police Department using the standard method of marking tires and re-checking the tires at certain intervals during the day.

12. Question: If residents have more than one vehicle, will each vehicle be able to display a sticker?

Answer: Each vehicle belonging to a resident of an affected area would be eligible for a sticker.

13. Question: Can a city resident from one zone park for more than two hours in another zone?

Answer: No, a sticker is only valid in the zone in which it has been issued.

14. Question: Will the stickers be transferrable?

Answer: No, each sticker will bear the vehicles license number and if the numbers don't correspond, the vehicle will be ticketed.

15. Question: Will students and other temporary residents be eligible for stickers?

Answer: Yes, but only if they can prove that they are actual zone residents and meet the District's requirements for vehicle registration.

16. Question: How often will the stickers have to be renewed?

Answer: Annually.

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17. Question: Is this program now in effect in other cities?

Answer: Yes, similar programs have been quite successful in Boston, Cambridge, Wilmington and Richmond.

18. Question: When can the program be implemented?

Answer: We are confident that the program can be implemented in certain areas of the city some time this summer.

19. Question: How many vehicles will be affected by the program?

Answer: Our studies indicate that approximately 10,000 vehicles will be affected.

20. Question: What alternatives will these vehicles have in seeking a mode of transportation?

Answer: We believe that the majority of these vehicles will be able to utilize our fringe parking programs, the area-wide car pool program, and the improving bus system.

21. Question: Will there be provisions for individuals who live in areas not adequately served by mass transit?

Answer: We are presently studying this problem. However, we are confident that METRO is making positive steps to improve their level of service from a comprehensive standpoint.

22. Question: Will all residents in apartment houses be eligible for sticker?

Answer: Yes, the sticker applies to all zone residents.

23. Question: How can an area become a part of this program?

Answer: Each area must submit a block by block petition containing signatures of the majority of the households in each block.

24. Question: Will an area with a two-hour restriction currently in effect be eligible for inclusion in the program?

Answer: Yes, this area has already exhibited a need for restricted parking.

PETITION

The undersigned residents of the ____________ block of ____________ ____________ Street petition the Mayor-Commissioner and City Council to designate said street as part of the Residential Parking Permit area by restricting the parking of vehicles beyond a consecutive two (2) hour period between the hours of 7 a.m. and 6:30 p.m. on weekdays, except holidays, to vehicles bearing a valid parking permit.

It is our understanding that the residents will bear the administrative costs of the program and this fee and other aspects of the program will be discussed at a public hearing held for each affected area prior to the implementation.

Signature	Address

APPENDIX B

METHODOLOGY FOR SURVEYS OF PRIVATE EMPLOYERS WITH REGARD TO EMPLOYEE PARKING

These informal surveys were conducted in August (Rosslyn) and October (D.C.) using telephone interviews. Lists of Rosslyn employers were prepared from a field inventory of building registers in the Rosslyn CBD and telephone numbers were obtained from the Northern Virginia Directory. In the case of D.C., names of private employers were pulled from the Yellow Pages according to category and location. The surveys were biased towards large employers to get maximum employee coverage although small businesses were also sampled.

Each inquiry followed the same format. The interviewer would ask to speak to the Office Manager or Personnel Director who could furnish information on employee parking. The purpose of the survey (to provide information for a Parking Management Study being prepared for the U.S. Environmental Protection Agency) was explained, and the following data collected:

1. What is the total employment for this company within Rosslyn (D.C.)?
2. For what percentage of employees is parking provided?
3. What is the cost to the employee for this parking?
4. If parking is not provided, is the employee reimbursed for parking costs?
5. What is the policy behind provision of parking or reimbursement for parking costs to the employee?
6. Does the employer offer any incentive to carpool?

The number of employers and the employees they represent are given in Table B-1 as well as the number of employees for whom parking is 100 percent subsidized. The number of employers does not represent all those who were telephoned; in some instances it was not possible to obtain the information (the Office Manager was not available, the company was not located in D.C. or Rosslyn any more, etc.). In cases where no data was collected, these employers were not counted in the survey.

These surveys are limited in scope and design but indicate the need for further investigation of the extent of private employers' parking subsidies. Parking management strategies which fail to consider the impact of private subsidies may be much less successful than anticipated.

TABLE B-1

RESULTS OF PRIVATE EMPLOYER SURVEYS

	D.C.	Rosslyn
Number companies sampled	48	29
Number employees represented	11,891	2,803
Total number of employees in target area	492,266	19,833
Percent of target area employees represented in the survey	2.4%	14.1%
Percent of employees with fully subsidized parking	48%	84%
Percent who must pay own parking	52%	16%

APPENDIX C

STEPS IN ASSESSING THE AIR QUALITY IMPACT OF A PARKING MANAGEMENT PLAN

APPENDIX C

STEPS IN ASSESSING THE AIR QUALITY IMPACT OF A PARKING MANAGEMENT PLAN

There are seven basic steps to projecting the impact of parking management on air quality. They are:

(1) Characterize existing air quality
(2) Characterize auto use
(3) Develop a current emissions inventory
(4) Project total emissions wihtout Parking Management
(5) Estimate future air quality without Parking Management
(6) Estimate future impact of parking management on auto use
(7) Estimate impact on future air quality

For major metropolitan areas much of the data necessary to generate an estimate of the parking management plan impacts are readily available in some form. Existing air quality, auto use, and emission projections were used in the assessment of this proposed in Washington D.C. plan. However, the development of site specific data and continuous monitoring of the program impact can be of significant additional value. For each of the seven steps, the direction and extent of analysis will be briefly discussed below.

Existing Air Quality

To characterize existing air quality one should collect all available data on nitrogen dioxide, oxidant, and carbon monoxide for the last couple of years. Data should be collected from all monitors in the region. Although summary data for previous years may appear in various reports of transportation planning documents, it is best to contact directly those persons actually conducting the monitoring programs to obtain their most recent set of data (normally less than one year old), find out if previously reported levels are still considered valid and representative, and to determine locations of monitoring equipment and the analytical methods used. Where possible, data trends should be evaluated on both a site-by-site and region-wide basis. If different test methods have been utilized, potential differences due to the test procedure itself must be considered.

The air quality data should be evaluated on the basis of averaging times consistent with Federal or State air quality standards. For Federal standards the averaging times are one hour for oxidants, one and eight hours for carbon monoxide, and annual average for nitrogen dioxide.

Examination of recent air quality trends will indicate the extent of auto related air quality problems (how badly are air quailty standards being exceeded), the effectiveness of on-going controls, and the representativeness of each year's data (one year may have had particularly bad or good meteorology and concurrent non-representative bad or good air quality).

In characterizing existing air quality it may be found that air quality is not monitored in an area of particularly high emissions and where parking management is likely to have a significant effect on auto use patterns. Development of a new monitoring program should be considered to characterize this potential pollutant hot spot and to track the effectiveness of parking management on that area's air quality.

Auto Use

In the development of the parking management plan, it is likely that all relevant data on auto useage directly related to parking spaces has been collected and evaluated. However, one may need to gather or estimate figures on mileage, trip frequency, and trip types on a regional or subregional scale in order to get at pollutant emissions' impacts of parking management.

Both the number of trips and length of trips influence automotive emissions (cold start-up emissions of hydrocarbons and carbon monoxide are typically high). The distributions of auto use by time of day can affect the impact of the emissions on air quality (early morning emissions of hydrocarbons are not influential on afternoon oxidant levels). Temporal distribution of trips may also indicate which trips and how many trips are affected by a particular parking measure.

Characterizing auto use by trip-type is necessary for evaluating measures aimed at particular types of trips (commute, shopping, business, etc.).

General information on number of trips, and auto mileage are normally available from local air pollution and transportation agencies. Specific information useful in disaggregating summary figures by time of day and type of trip may be available from personal auto use surveys conducted in the area. Where such studies have not been carried out, studies carried out in other cities can be extrapolated. For Washington, D.C. data in the emission projections by COG, the 1972 long range regional plan, and a 1968 personal transportation survey were used to estimate distribution of trips by type and time of day.

Current Emissions Inventory

It is likely that sufficiently detailed emission inventory data on hydrocarbons, carbon monoxide, and nitrogen oxides are already available in air pollution implementation plans. In adapting existing inventories to the parking management analysis, one must consider up-dating the inventory if assumptions regarding control effectiveness have changed. One must also check the compatability of the auto use figures to be used with those in the inventory. If the auto use figures are in conflict with the inventory, a revised inventory can be developed, using EPA AP-42 report series on emission factors. The baseline inventory, auto use data, and air quality data should all be for the same year. This may mean using data from two or three years past to obtain the desired consistency.

Readily available emission inventories are normally based on region-wideor county-wide emissions. For oxidant and nitrogen dioxide concentration analysis, where delays between primary pollutant (HC and NO) emission and secondary pollutant formation take place, development of smaller scale inventories is of little value. For a primary pollutant such as carbon monoxide, the use of a localized inventory may be in order. This can be developed using standard EPA inventory techniques and data on localized CO stationary sources and motor vehicle use. State and local air pollution control agencies can often provide insight and necessary data for developing such an inventory.

For short-term standards such as those for oxidants and carbon monoxide maximum concentrations are likely to occur consistently during a particular part of the day. To the extent these maximum concentrations can be related back to emissions during a particular part of the day and an emission inventory can be developed accordingly, a more accurate representation of relevant pollutant emissions will result. In the case of Washington D.C., the GOC has developed the hydrocarbon inventory around the 6 to 9 a.m. period, and the carbon monoxide inventory around the 2 to 10 p.m. period. This is because 6 to 9 a.m. HC emissions are expected to convert and have a major impact on 12 to 2 p.m. oxidant levels and because ambient CO levels are highest in the afternoon period. Either time specific or daily inventories are acceptable analytical approaches at the present time.

Projecting Emissions without Parking Management

Development, implementation, and realization of parking mangement measures and their associated auto use reductions will all take time. As in this study the time frame of significant impact, which to a certain extent is dependent on the precise nature of the measures themselves, is likely to be the decade of the eighties. It would, therefore, be inappropriate to evaluate these measures in the context of current emissions and air quality and ignore the effects of growth in pollutant sources and the effects of on-going or planned control efforts. Emission and air quality levels must be estimated for appropriate future years to obtain a meaningful assessment of parking management. In projecting emissions one must take into account the combined effects of source growth, the impact of retirement of older sources, and the effects of various State, Federal, and Local emission control programs.

This can prove to be a complicated and tedious task. Fortunately, however, as with the baseline inventory, one or more existing emission projections are likely to be available for any major metropolitan area. In Washington, D.C., for example, projections to 1975 and 1977 were prepared for use in the Transportation

Control Plan, projections to 1985 were developed in support of Air Quality Maintenance Planning efforts, and a 1992 projection of emissions was done as a part of the long range transportation plan consistency assessment now required by the Federal Highway Administration.

When using existing projections one should consider the validity of the growth rate, and control programs' assumptions used in the original projection exercise. If data are drawn from two or more different projections, consistency between them must be established.

If original projections are to be developed either because previous efforts are outdated, cannot be validated or provide insufficient detail, procedures used by local air pollution agencies should be followed as closely as possible. Generalized guidance can be found in EPA's 13-volume Air Quality Maintenance Plan Guidelines series.

Future Air Quality without Parking Management

Projecting future air quality involves estimating the impact of shifts in the quality and type of emissions, as reflected in the emission projections, on air quality as a function of the level or levels observed in the baseline year. The simplest of approaches, which is typically used, is to assume a proportional change relationship between emissions and air quality. For pollutants such as carbon monoxide or ntirogen dioxide the following is applicable:

$$Ci = CO \times \frac{Ei}{Eo}$$

where,

Ci = projected air quality level.
Co = observed base year air quality level.
Eo = baseline year total emissions.
Ei = the projected total emissions.

Because oxidants are produced through complex hydrocarbon reactions in the atmosphere, a non-linearity factor is often introduced. A typical formula for projecting oxidant air quality is:

$$Ci = (Co \times Fo \times Ei)/(Fi \times Eo)$$

where,

Ci = projected oxidant air quality level.
Co = observed base year air quality level.
Fo = weighting factor which accounts for any non-linear relationship between hydrocarbons emitted and oxidants observed in the baseline year.
Fi = the weighting factor in the projected year.
Eo = baseline year total hydrocarbon emissions.
Ei = the projected total hydrocarbon emissions.

The factors Fo and Fi are based either on aerometric data1/ or on an assumption of direct proportionality between hydrocarbon emissions and oxidant concentrations, i.e., Fo=Fi=1.0. The exact relationship is still not known.

Parking Management's Effect on Auto Use

To assess the impact on auto use of the parking management plan one must clearly define the cost and supply assumptions explicit or implicit in the baseline air quality and emissions projections. The baseline projection is likely to reflect a status quo assumption (i.e., price levels and structures, types of parking and ratio of parking to travelers unchanged). From this baseline one must then identify price changes, and supply changes expected in the year in question due to the plan and evaluate which trips and which travelers will face these incremental changes.

1/ For example Appendix J, "Requirements for Preparation, Adopting, and Submittal of Implementation Plans," Code of Federal Regulations, 40 CFR 2.100.

In this study, those travelers facing price increases due to elimination of previously free parking were diverted on the basis of the full price for the duration of parking typical to the trip type in question (commute, shopping). Those facing increases in price due to rate increases were diverted based on the shift in price before and after parking management. Diversion of trips in essence reflects the shift in the split of travelers between driving and parking, and carpooling or using mass transit. A series of diversion curves (examples on the next page) were already available for Washington from previous work in the area. If diversion estimates specific to the region being analyzed are not available, data from other cities can be reasonably substituted. Diversion curves based on cost ratios and time ratios of autos vs. transit are particularly useful in this respect. These kinds of curves are also available for the Washington area.1/

Where free or cheap parking is eliminated with substitutable space available, proportional diversion due to increased cost and time is appropriate. Where alternative space is not available one must assume 100 percent diversion to transit or carpool. However, this assumption can be inappropriate if the supply/demand imbalance is great and alternative modes of travel are not adequate. Under such conditions, cruising in search of space and chauffeuring of travelers can actually increase auto use and associated emissions. These conditions should be avoided.

New and better parking can be evaluated in a reverse evaluation of transit diversion as in the case of fringe lot development.

Operating on these principles one can approximate the changes in trips (number of trips, length of trips, and destinations) due to shifts in parking supply (volume, cost, and location). Distributing travel by type of trip and time of day is useful in

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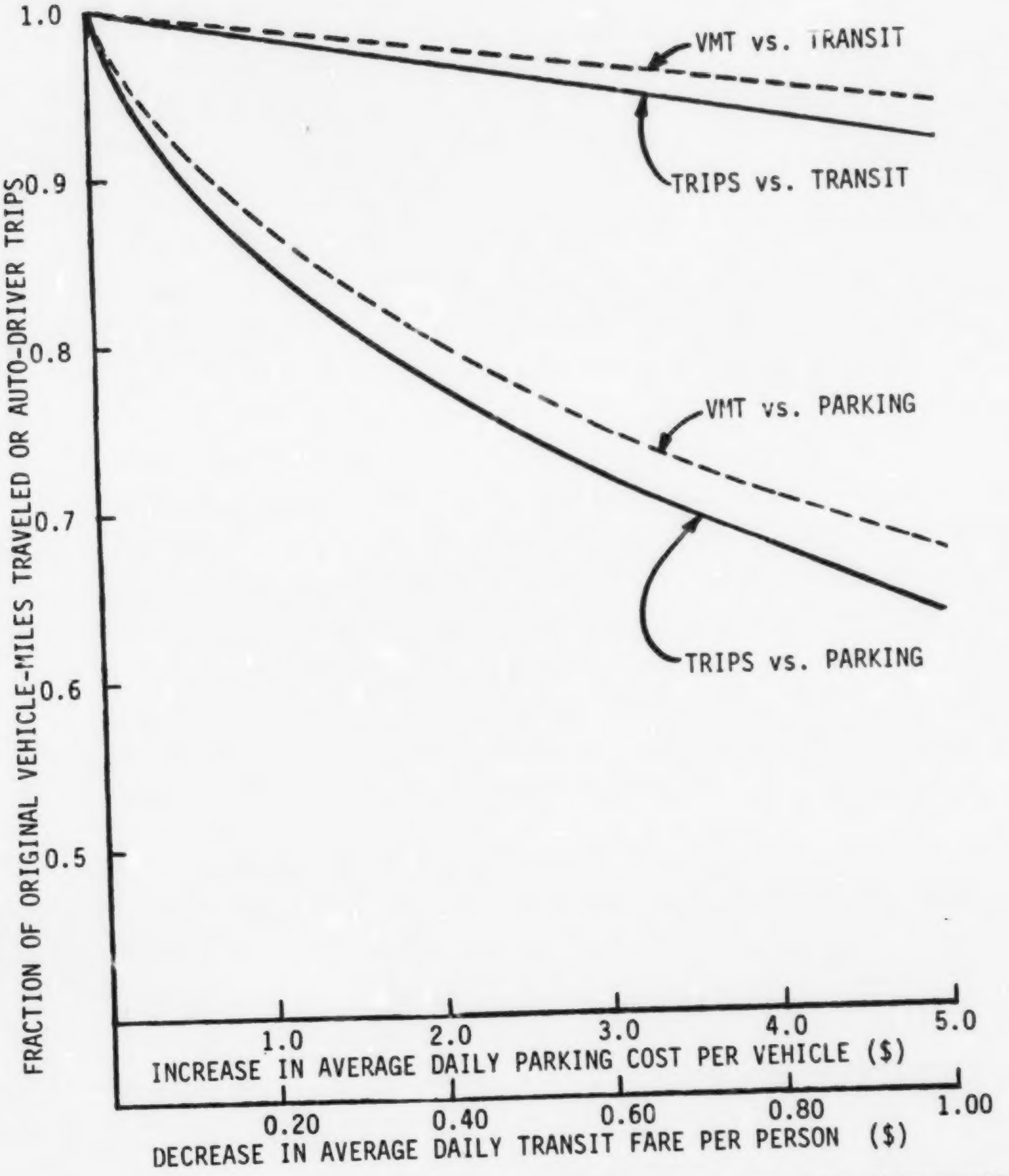
1/ Modal Split Curves in "Software Systems Program Development", DOT, UMTA, 1974.



DIVERSION OF AUTO USE AS A FUNCTION OF ECONOMIC INCENTIVES this respect (e.g., Is parking supply constrained at any particular time of the day and which travelers will face this constraint or to what degree are morning and afternoon peak traffic flows affected by measures aimed solely at commuters).

The goal of this particular exercise is to come up with an estimate of the reduction in both number of trips and miles traveled throughout the day resulting from the plan.

Air Quality Impact of Parking Mangement

Emissions of HC, CO and NO_x are a function of both trip length and frequency. Start-up emission of HC, and CO are high while NO_x is somewhat low. For this reason the emissions due to one five-mile trip are different from those due to five one-mile trips. To date this interaction between trip length and frequency has been important in accurate emission characterization. It is likely to continue to be important in future car emissions. Data relating the portion of emissions attributable to start-up as opposed to running operation cannot be developed for autos to be sold between now and the year of years being projected. In this analysis both the percentage reduction in number of trips and number of miles were used to bound the potential reduction in auto emissions.

Reducing auto use will stimulate demand for transit. If the increased demand is absorbed in current transit service, no change in transit emissions need to be considered. If, however, transit service frequency will be increased due to parking management stimulated demand, the net emissions impact assessment must reflect the negative effect of increased transit emissions. Necessary emission factors for this inclusion are provided in EPA's AP-42 report series on emission rates.

Percentage changes in motor vehicle emissions, once derived, are directly relatable to the projections of emissions and air quality discussed earlier in this Appendix.